

A NORMATIVE STUDY OF THE ACQUISITION
OF CONSONANT SOUNDS IN PORTUGUESE

BY

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KEY TO SYMBOLS

Throughout this paper, several symbols have been substituted for International Phonetic Alphabet (IPA) symbols unavailable either in the text or figure fonts.

- /L/ = /ʌ/, alveo-palatal, lateral liquid, voiced consonant
/ñ/ = /ɲ/, alveo-palatal, nasal, voiced consonant
/R/ = /x/, lingua-velar, lateral liquid, voiced consonant

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Phonological acquisition is a topic that has fascinated researchers trying to solve the puzzle of how children learn to talk. A review of the literature provides a large body of information about the acquisition of English phonology. The study of Portuguese phonology is a rapidly growing discipline with several studies dating from 1992 to the present. Most of these studies have addressed the need to build a more theoretical basis to support clinical work with individuals with disorders.

The purpose of this study was to collect normative data on the acquisition of consonant sounds in Portuguese as spoken in Brazil. The data were used to answer four questions: (1) What percentage of children at each age level produced each consonant correctly? (2) What is the age of "customary production" for each sound? (3) What is the age of "acquisition" for each sound? (4) What is the age of "mastery" for each sound?

An existing articulation test of Portuguese was used to collect samples from 192 normally developing children between the ages of 2:0 and 6:11. The children represented eight age groups with 12 boys and 12 girls in each group. The children's responses were tape recorded and transcribed by two listeners for later analysis.

The consonants were considered separately in all positions in which they occurred. The percentages of accuracy of each consonant sound were analyzed and indicated a rapid development between 2:0 and 2:6 with continued but slower development in older groups. No significant differences were found between the performances of girls and boys. The ages of acquisition were compared to English and Arabic. Customary production tended to come later in Portuguese but mastery occurred earlier than in the other two languages. The voiceless consonants were produced more accurately than their voiced cognates. In the younger groups the word initial consonants were less accurate than the same consonants within words. Unlike the findings of other languages, the liquids were learned before the fricatives. Other patterns of acquisition found were similar to those reported in other languages.

CHAPTER 1 INTRODUCTION

The acquisition of the phonology of languages has been studied for several purposes. Much of this research has been undertaken to add to the theoretical point of view of the researcher. However, such studies can also have practical purposes. Precise information on the ages of acquisition of sounds and sound sequences is needed for formulating articulation test instruments, for making diagnostic decisions about the status of the speech of individual children, and for planning remediation when problems are found. Since 1960, assessment batteries for articulation have included sound inventories—articulation tests—usually elicited by picture naming. Although such tests are useful to the speech-language pathologist, they have been widely criticized in the literature (Ingram, 1989; Irwin & Wong, 1983; Olmsted, 1971; Stoel-Gammon & Dunn, 1985).

Frequent criticisms have focused on the lack of validity of testing speech by naming pictures. Problems with picture naming include the choice of words, the type of words, and the testing of only one sound in the word. The selection, screening, and numbers of subjects tested have also been criticized by those who would like to generalize data to other groups. Based on some of these criticisms, recent researchers have made attempts to remedy the problems by conducting

further normative studies and by developing newer forms of the tests. Some of the changes introduced by these researchers were minor, such as including more items, using vocabulary more appropriate to the subjects tested, controlling word structure and familiarity, targeting more than one sound per word, and using more realistic pictures (Al Amayreh, 1994; Ingram, Christensen, Veach, & Webster, 1980; Smit, Hand, Freilinger, Bernthal, & Bird, 1990; Yavas, 1988). In addition, major changes have been made. These included a shift toward more phonemic detail in scoring instead of correct/incorrect, a shift from sound by sound analysis to pattern analysis, the inclusion of normative data that allow clinicians to compare a child's performance at a particular age to norms from the instrument (Khan & Lewis, 1986; Lamprecht, 1993; Prather, Hedrick, & Kern, 1975; Preisser, Hodson, & Paden, 1988; Sander, 1972; Smit et al., (1990).

Most of the commonly reported studies of phonological acquisition have been conducted in English. However, it is clear that the phonologies of languages different from English may develop in different ways and at different rates (Wertzner, 1992). The language of interest in this study was Portuguese. Portuguese is a Romance language spoken in Portugal, Brazil, Mozambique, Angola, and parts of Africa and Asia. In Brazil alone, approximately 160 million people speak this language. The practice of speech-language pathology is well developed in Brazil, but the number of normative studies of the sound system are few. Clearly, the development of Portuguese phonology is of interest to a great many people.

In the following chapter some of the most important methodological issues in the collection and analysis of phonological acquisition data will be discussed, especially as these have been addressed by researchers in the United States. An overview of the phonological system of Portuguese will be presented and compared briefly to English. Finally, the few available reports on phonological acquisition of Portuguese as spoken in Brazil will be presented.

The purpose of this study was to collect further normative data on the acquisition of Portuguese. In this study an attempt was made to remedy some of the problems found by researchers in other normative studies.

CHAPTER 2 REVIEW OF THE LITERATURE

Methodology of Studies of Sound Acquisition

The empirical problems in normative research are many. Some of those problems have been addressed by researchers in terms of how they apply to the study of sound acquisition (Ingram, Christensen, Veach, & Webster, 1980; Irwin & Wong, 1983; Morrison & Shriberg, 1992; Smit, 1986). In this review the focus will be on subject selection and sample size, word selection and elicitation methods, and methods of analysis and presentation of norms. Those aspects will be discussed in the context of several studies of English and the limited studies that have been reported on Portuguese.

Normative Research

Normative research was defined by Hegde (1987) as the type of research in which the distribution of selected dependent variables across age groups is observed and recorded. A study of the acquisition of sounds could report, for example, the number of phonemes correctly produced (dependent variable) by 2-, 3-, and 4-year-old children from a particular population. According to Hegde, the major purpose of normative research is to arrive at norms that are the averaged performance levels of presumably typical reference groups.

For clinical disciplines, such as speech-language pathology, developmental norms are extremely important because they tell us how children's speech behaviors change as they grow older. This information helps in making clinical judgments as to whether a given child's behavior is within the expected age range or not. However, the literature review shows that there has been a variety of purposes for conducting studies of phonological acquisition, and the studies have differed somewhat to accommodate their purposes. Because of such differences in methodology, they are not always comparable to each other and are not of equal value for the speech-language pathologist.

Purposes of Normative Studies

A summary of some purposes of selected studies can be found on Table 2-1. It should be noted that this table includes studies of both English, summarized by Al Amayreh (1994), and of Portuguese. In this paper, emphasis will be given to studies of the type included under Purposes 1, 2, 4, 6. Smit (1986) reviewed seven of the major normative studies of English (Arlt & Goodman, 1976; Irwin & Wong, 1983; Olmsted, 1971; Poole, 1934; Prather, Hedrick, & Kern, 1975; Templin, 1957; Wellman, Case, Mengert, & Bradbury, 1931), looking especially at their methodologies as these might affect the ages of acquisition reported. She concluded that "the major differences among the elicited speech investigations occur in the area of subject selection, method of obtaining the speech sample, and analysis procedures" (p. 177). Further discussion regarding the differences in methodology between the studies will be addressed in sections below.

Table 2-1. Major purpose of the studies reviewed.

Major Purpose of Study	Conducted by
1. To provide normative data on speech sound acquisition for a specific group of children (e.g., particular state or region); those in a particular age group; or a particular language.	Al Amayreh, 1994; Smit et al., 1990; Preisser et al., 1988; Stoel-Gammon, 1985, 1987; Yavas, 1988; Wellman et al., 1931; Poole, 1934.; Silverio et al., 1993; Hernandorena, 1993; Wertzner, 1992
2. To provide normative data on speech sound acquisition as a part of a larger study of other aspects of language development.	Templin, 1957
3. To examine a particular aspect of phonology at different times.	Lamprecht, 1993; Vihman & Greenlee, 1987; Dyson, 1988
4. To replicate previous normative studies to take into account changes in age of acquisition due to current rearing practices, technology, and educational procedures.	Arlt & Goodban, 1976; Prather, et al., 1975
5. To study the effect of methodological factors on age of acquisition	Ingram et al., 1980
6. To provide normative data on speech sound and distinctive feature acquisition using a different elicitation procedure than that typically used	Irwin & Wong, 1983; Prather et al., 1975; Ohmsted, 1971
7. To examine errors made by children learning their language	Templin, 1957
8. To identify the phonological processes that account for various types of errors in a group of normal children	Khan & Lewis, 1986; Preisser, et al., 1988; Mota, 1993
9. To develop normative data for a test, either the development of a test or follow-up of an existing one	Khan & Lewis, 1986; Templin, 1957

Subject Selection and Sample Size

Normative research has typically used the stimulus and response sampling procedure to establish the statistically averaged response patterns across age groups. Theoretically, norms are established on randomly selected subjects who are representative of the population. Several researchers have emphasized that certain variables must be controlled in order for the results of normative studies to have value (Ingram et al., 1980; Smit et al., 1990). Specifically, the sample must be representative if the conclusions are to be extended to all children in the population.

Subject characteristics

In their selection of subjects, most researchers make an effort to ensure that the sample reflects the socioeconomic distribution of the population as a whole. Also, audiometric screening and parental report are typically used to exclude children with hearing losses or delayed language development. However, different criteria for subject selection have been used depending upon each researcher's belief about factors important to his or her purpose. For example, Smit et al. (1990) were only concerned with studying children from a particular region of the United States—Kansas and Nebraska; Stoel-Gammon (1985) was looking at a particular age group, children under the age of 2.

Khan and Lewis (1986) pointed out the need for subjects in different age groups to have similar backgrounds (gender, ethnic, and geographical). Their subjects were also screened to exclude physical abnormalities and to guarantee

normal function of the speech mechanism. They did not express a particular concern about screening or controlling the socioeconomic status. Templin (1957), however, was much more concerned with socioeconomic level. She weighted her sample heavily on the lower end of the socioeconomic status scale (70% lower, 30% upper, based on father's occupation) and included only urban children, all monolingual. Although all of her subjects were from Iowa, she stated that she tried to represent the general population of the United States in her subject group in the distribution of socioeconomic status. Templin (1957) did not screen hearing or language development even though there are indications that even a mild problem in either area might affect the age of sound learning (Ingram, 1989).

Prather et al. (1975) also attempted to mirror the socioeconomic makeup of the general population of the United States in their subject sample. They selected one-third of each age group from three different classes based on education and occupation. Only Caucasian monolingual children were included and those with hearing loss or language disorders were excluded. Arlt and Goodban (1976), on the other hand, claimed that their subjects represented an average socioeconomic population but did not describe how this was determined. The majority of their subjects were white with some other races in each subgroup. They included only monolingual subjects and screened for normal I.Q., emotional problems, and/or hearing problems.

Both of the two early studies, Wellman et al. (1931) and Poole (1934) observed children from university laboratory schools, making their populations very selective. All subjects were from upper socioeconomic status with fathers who were graduate students. A very narrow sample of children such as this, all drawn from a specific group, is probably not a representative sample from which generalizations to larger populations could be made. No other factors were reported to have been screened in these two studies to determine subject exclusion.

Olmsted (1971) was the only researcher who specifically included some children with parents who spoke English as a second language or non-American dialects. However, he observed primarily children of professors and graduate students. No control for hearing status or language development was reported.

A brief review of subject selection procedures in some other studies of English found that Irwin and Wong (1983) selected subjects with middle social economic status, all Caucasian. They screened for hearing, previous language therapy, and dentofacial abnormalities. Stoel-Gammon (1985, 1987) selected subjects who were monolingual and screened for hearing, cognitive development, and motor development. Preisser, Hodson, and Paden (1988) included subjects from middle and lower-middle socioeconomic levels, all monolingual. They screened for hearing, "general function," language development, and voice. In the most recent study, Smit et al. (1990) stated the population density of their subjects' residences and the parental education of their subjects, all of whom were

monolingual and spoke a "standard Midwestern dialect." The subjects were screened for hearing, motor speech problems, and oral-facial abnormalities.

A study conducted by Silverio, Parlato, Mourão, Altmann, and Chiari (1994) looked at the occurrence of Portuguese phonemes produced by preschool children of public versus private schools. The researchers controlled the subject selection to ensure the same number of males and females in each group. A screening was conducted to control for normal language development and normal speech mechanism. It should be noted that in Brazil the majority of children who enroll in public schools are from the lower social economic layer of the population. Other studies looking at the phonological acquisition of Portuguese (Hernandorena, 1993; Lamprecht, 1993; Yavas, Hernandorena, & Lamprecht, 1991) controlled the subject selection in terms of gender, age, and normal development. One study of Portuguese phonology (Mota, 1993) looked at a specific group. She evaluated the validity of a phonological therapy model (Hodson & Paden, 1986); therefore, only children with developmental phonological disorders were selected.

Age range

Normative research is typically concerned with the distribution of behaviors across age groups. The age groups are usually selected according to the purposes of the study (e.g., to include very young children to extend existing age norms). The age ranges in the studies reviewed have generally fallen between 2 and 8 years. Also, studies have varied in the earliest age tested and in the intervals

between and within age groups. Some studies started at a very young age, from 12 to 18 months or even younger (e.g., Ingram et al., 1980; Irwin & Wong, 1983; Preisser et al., 1988; Stoel-Gammon, 1985, 1987; Vihman & Greenlee, 1987; Olmsted, 1971). Another group of studies started at 2 years or at 2:6 (Khan and Lewis, 1986; Poole, 1934; Prather et al., 1975; Wellman et al., 1931). Arlt and Goodban (1976), Smit et al. (1990), and Templin (1957) started at 3 years of age.

The age range of subjects is important when considering the usefulness of the data. For example, inclusion of young children allows more opportunities to see if sounds were acquired earlier than had been previously reported.

Unfortunately, in studies of very young children, it was often reported that a large number of young children did not respond to all stimuli. In addition, studies that included only very young children usually reported a smaller sample size and were typically undertaken for special purposes. For example, Preisser et al. (1988) studied a particular age group to identify phonological processes, and Stoel-Gammon (1985, 1987) studied a particular age group to extend previous norms into younger age groups. Arlt and Goodban (1976), who started at age 2:6, and Poole (1934), who started at age 3, did not report on the completeness of their data (Smit, 1986). The frequently used norms collected by Templin (1957) started at age 3. All sounds that had already been acquired by her subjects before that age were simply reported as being acquired at 3 years. Such a presentation of data can be misleading for clinical diagnosis.

In cross-sectional research such as most of the phonological acquisition studies, a decision must be made about the age interval within groups. Most of the studies reviewed used 6-month or 1-year intervals, often with smaller intervals for younger children, assuming that more rapid changes would occur in these groups. For example, Templin (1957) allowed 6-month groups up to age 5 and 1-year groups between 6 and 8 years. Narrower age groups were used by Prather et al. (1975), four age groups per year (e.g., 24, 28, 32, 36 months) with each subject falling within one month before or after the mid-point (e.g., 23-25, 31-33, etc.)

The studies of Portuguese phonology reviewed presented age ranges similar to the ones used by studies of English. Hernandorena (1993) studied children as young as 2 and up to 4:3. The children were divided into 14 groups with a 2-month age range in each group. Yavas et al. (1991) studied children from 2:4 to 4:4 years of age. Silverio et al. (1994) studied preschool children from 2:6 to 5:6 years of age divided into three groups with a window of one year each. Lamprecht (1993) studied the phonological acquisition of Portuguese speaking children between age 2:9 to 5:5.

Sample size

The sample size is a very important consideration in any research study. In normative research, decisions about the number of subjects to study represent a real challenge. Hegde (1987) reminds us that any population is heterogeneous. When a large number of persons are studied, there is much variability. Therefore, a good sample must be heterogeneous, but the more heterogeneous the sample,

the more variable the performance. Unfortunately, the more variable the performance, the less meaningful are averaged data (the norms). "In other words, even when an investigator achieves a representative random sample, the resulting norms will be highly variable, a contradiction of terms" (Hedge, 1994, p. 85).

The great variability in sample sizes included in the normative studies reviewed can, in most cases, be attributed to differences in the purposes of the studies. Templin (1957), Khan and Lewis (1986), and Smit et al. (1990) used very large samples (480, 852, and 997, respectively) to provide normative data on speech sound acquisition. These samples have been divided almost evenly between boys and girls.

Two studies that were intended primarily to replicate previous normative studies used smaller samples for this purpose; Arlt and Goodman (1976) included 240 subjects, and Prather et al. (1975) included 147 subjects. Both Olmsted (1971) and Irwin and Wong (1983) included 100 subjects in their studies, which attempted to show the use of different elicitation procedures to provide data on speech sound and distinctive feature acquisition. Al Amayreh (1994) included 180 subjects, starting with children as young as 2:4 in his normative study of Arabic. Preisser et al. (1988), Stoel-Gammon (1985, 1987), and Vihman and Greenlee (1987), observed much smaller samples of children to study development in very young children with more detail than is possible in the large sample studies.

Mota (1993) studied a small sample of three children because she was looking at the effects of a detailed phonological process therapy. Lamprecht

(1993) also reported a fairly small sample of 12 children in her longitudinal study of acquisition of Portuguese phonology. Wertzner (1992) looked at 56 children and Yavas (1988) included 72 children in their studies of the phonological development of Portuguese speakers. Hernandorena (1993) studied a larger sample of 134 Portuguese speaking children when looking at the stages of phonological acquisition.

Word Selection and Elicitation Methods

Elicitation methods

The method used for eliciting the speech sample from the subjects in normative research has varied somewhat and is usually determined by the purpose of the study. Elicitation methods can be classified under two major categories: single words and conversational samples. Single words can be collected either in spontaneously evoked samples (picture naming, reading, and sentence completion) or in imitative samples (direct imitation or with some intervening time delay or words between the model and the imitation).

To obtain single-word samples, children typically are asked to name a picture representing a target word. If the child does not produce the word spontaneously, Bernthal and Bankson (1993) have suggested that a response should be elicited by giving some prompts first without giving a model. If the child still does not produce the word spontaneously, a delayed imitation can be used whereby the examiner names the picture and then says something to diminish the influence of the spoken cue; the last recourse is to use direct

imitation. It is important that words elicited by different methods should be analyzed separately if possible instead of combining all responses as if they were elicited in the same way.

The majority of studies have used single words as a method for collecting data using pictures or objects. However, different procedures have sometimes been used when no spontaneous response was obtained. A brief review of some frequently reported studies indicated that Wellman et al. (1931) used spontaneous picture naming; Poole (1934), Preisser et al. (1988), Khan and Lewis (1986), and Smit et al. (1990) used spontaneous naming of pictures, objects, actions, or questions with delayed imitation, or imitation, if needed; Templin (1957) used either spontaneous or imitated picture naming; Arlt and Goodban (1976) used imitation throughout. Prather et al. (1975) followed a sequence of spontaneous, cues, forced choice questions, and then imitation, or no response. Ingram et al. (1980) used sentence completion, sentence recall, *and* imitation.

Conversational samples have also been used to collect data about articulation and phonological acquisition. Such samples have the advantage of using spontaneous connected speech, and the words are used in meaningful and real contexts. There are also some disadvantages because this method requires more time to obtain and analyze the sample, some sounds may not be represented in the sample, and the results cannot be compared to most of the norms available.

Of the studies reviewed in this paper, Olmsted (1971), Irwin and Wong (1983), Stoel-Gammon (1985, 1987), and Vihman and Greenlee (1987) used

conversational samples. The method of data collection varied. Olmsted (1971) used play sessions with the children; Irwin and Wong (1983) used non-structured conversation exchanges and tape recorded the sessions; Stoel-Gammon (1985, 1987) tape recorded interactions with caretakers and children using the same set of toys for all subjects; and Vihman and Greenlee (1987) tape recorded and videotaped play sessions with mother and family peers and studied the production of fricatives and clusters with pictures.

Spontaneously evoked samples of single words and imitated samples have been criticized for several reasons. Critics point out that production of single words may differ from the production of the same words by the same children in connected speech—a problem of validity (Morrison & Shriberg, 1992); each sound is targeted only once in each position and the consistency of production cannot be assessed—a problem of reliability; and children's performance may vary based on the familiarity and/or the structure of the word—a problem of both reliability and validity (Bernthal & Bankson, 1984; Ingram, 1989). Some attempts have been made to evaluate these possible differences in results due to the method of elicitation (e.g., Ingram et al., 1980; Ingram, 1989; Kenney & Prather, 1984; Stoel-Gammon & Dunn, 1985; Templin, 1947), and each study contributed to important methodological considerations to be taken into account. However, the conclusions of most of these studies indicated that only very small differences will appear in the final results and that these differences should not rule out the use of a single-word elicitation method if it appears to be the most useful and usable for a

particular study (Morrison & Shriberg, 1992). The purpose of a study should determine the elicitation method used. To emphasize this point, Ingram (1989) noted that regardless of the differences in the elicitation and analysis procedures, Templin (1957), who used single words, and Olmsted (1971), who used only conversation, obtained almost the same results.

Word selection

The selection of words used in normative studies has been dependent mainly on the inclusion of target sounds needed in the corpus to satisfy the purpose of the studies. Most normative studies have been based on samples elicited from one single word for each sound in three positions—initial, medial, and final. However, Prather et al. (1975) and Smit et al. (1990) tested only two positions, initial and final. Arlt and Goodban (1976), Khan and Lewis (1986), and Preisser et al. (1988) tested more than one sound per word in an attempt to keep the number of words small. Ingram et al. (1980) and Smit et al. (1990) tested each sound of interest in each position of interest more than once.

Sounds tested

Most normative studies reviewed included the majority of consonant sounds of the language. Consonant clusters were included to some extent in most studies, but vowels and diphthongs often were not tested. Wellman et al. (1931) and Poole (1934) excluded infrequently occurring sounds. Ingram et al. (1980) included only a selected group of sounds, because the study had a specific purpose in examining these sounds.

Methods of Analysis and Presentation of Norms

Criterion for acquisition

In studies of sound acquisition, a criterion is set to determine "age of acquisition" for the group as a whole. The criterion for acquisition is set by the level of correctness of the sound specified by the researcher and varies considerably from study to study. Precise definition of acceptable responses is essential and can affect the results. Ingram criticized Templin (1957) for not considering normal variants of phonemes as acceptable in scoring. For example, an acceptable variant such as the flapped /t/ was considered to be incorrect. The issue of acceptable responses is also very important in languages that have various dialects and for normative studies conducted nationwide.

Poole (1934) set the highest criterion for acquisition, 100% correct production in all positions. Wellman et al. (1931) and Templin used correct production by 75% of the children in each of three word positions. Ingram et al. (1980) criticized the 75% criterion as too strict and suggested 70%. They required correct production of 70% of the child's four attempts to produce a sound. Prather et al. used correct production in two positions by 75% of the children, and the scores were averaged over the two positions. Smit et al. (1990) used correct production by 90% of the children in each age group in all positions, defending this high criterion as appropriate for state guidelines where their data were collected.

An important aspect in the discussion of defining a level of acquisition was brought up by Sander (1972). He argued that the typically used 75% criterion represented the "upper age limits rather than average performance" (p. 56). He suggested that different indices of speech sound achievement should be distinguished, and normative data should report at least two measurements: customary age and age of mastery. Mastery is generally preceded by at least three stages: (1) the first appearance of the sound, (2) the earliest correct articulation of the sound in words, (3) customary production (51% correct production in two positions), and finally (4) mastery (90% correct production in three positions).

Arlt and Goodban (1976), Ingram et al. (1980), Prather et al. (1975), and Smit et al. (1990) compared their results with those found in earlier studies. Agreements between the findings in the various studies were striking when the differences in methodology mentioned above are considered. However, the more recent studies have tended to report earlier ages of acquisition (e.g., Arlt & Goodban, 1976; Prather et al., 1975; Smit et al., 1990).

Analysis procedures

The normative studies reviewed have reported different types of scoring, different methods for reporting the data, different statistical analyses employed, and different procedures for handling error production. The simplest type of scoring in a test of sound production is to use "correct" and "incorrect" or 1 and 0. Templin (1957) gave one point for each correct sound out of a total possible of 176. She then looked at correct percentages for each consonant, for each position,

and for each type of consonant by manner. Smit et al. (1990) refined this procedure by scoring three types of responses: acceptable, not acceptable but with marginal differences, and incorrect.

Another commonly used scoring procedure (Prather et al., 1975) is a four-way system based on categories or degrees of correctness, such as Correct, Omission, Substitution, and Distortion (e.g., numerical values 0, 1, 2, 3). In other studies (Ingram et al., 1980; Preisser et al., 1988; Stoel-Gammon, 1985, 1987; Yavas et al., 1991), an IPA (International Phonetic Alphabet) symbol was assigned to the substituted or distorted sound. This gives more detailed information but suits small groups better than large groups. Such detailed information cannot be used in most statistical procedures, and the data are difficult to report in tables.

Reporting the data

A variety of methods for reporting data can be found in normative research on sound acquisition. Studies have often included the use of tables of norms (e.g., Khan & Lewis, 1986; Silverio et al., 1994; Templin, 1957), figures or graphs representing change over time (e.g., Prather et al., 1975; Smit et al. 1990), and percentages, percentiles, or standard scores (e.g., Khan & Lewis, 1986; Yavas et al., 1991). The data are usually reported separately by age group and by sex (e.g., Poole, 1934; Prather et al., 1975; Silverio et al., 1994; Yavas, 1988) and by the position of the sound in the word (e.g., Lamprecht, 1993; Templin, 1957; Wellman et al., 1931). Some studies also included data by socioeconomic status or

geographical area (e.g., Khan & Lewis, 1986; Silverio et al., 1994; Smit et al., 1990), by order of difficulty of sound classes (e.g., Silverio et al., 1994; Templin, 1957; Wellman et al., 1931; Yavas et al., 1991), and by phonemic environment, cluster, or singleton (e.g., Ingram et al., 1980; Smit et al., 1990; Templin, 1957).

A different method of reporting was used by Dyson (1988), Stoel-Gammon (1985, 1987), and Yavas et al. (1991). The phonetic inventories used by the children were examined entirely, and the overall percentage of consonants produced correctly was reported. In addition, the syllable and word shapes that commonly occurred were reported.

In a number of studies, error productions have been either ignored or simply counted. More recent research has emphasized the description of these errors by using narrow phonetic transcription. Errors have been described in terms of phonological processes, distinctive features, or exact substitutions and distortions used by the children (e.g., Irwin & Wong, 1983; Khan & Lewis, 1986; Mota, 1993; Prather et al., 1975; Preisser et al., 1988; Smit, 1993; Smit et al., 1990; Vihman & Greenlee, 1987; Yavas et al., 1991).

Due to their descriptive nature, most normative studies have not made extensive use of statistical procedures. If comparison between and among groups, such as differences between genders or socioeconomic status, were needed for the study, researchers have typically used a *t*-test or ANOVA to determine the significance of differences. Sometimes percentile ranks and standard scores have been computed as well.

Phonological Characteristics of Portuguese

This section of the paper presents an analysis of the main characteristics of Portuguese sounds based on their phonetic features and the way in which those sounds operate as a system. When the phonemes are combined in meaningful sequences, they interact with one another in systematic ways that can be explained by phonological rules. In this paper all references to Portuguese refer to the variants of the language spoken in Brazil unless otherwise mentioned. The inventory of phonemes used in Portuguese will be described.

The phonemic inventory of Portuguese is typically described as consisting of 19 consonants and 7 vowels. Following is a brief account of these sounds extracted from Mascherpe (1970).

Vowels

The vowels are classified by using the height and position of the tongue, from highest to lowest and from front to back, in conjunction with the shape of the lips, from spread or less rounded to very rounded. The vowels used in Portuguese can be seen in Table 2-2.

Portuguese vowels are all [+syllabic]; that is, they can be the nucleus of a syllable. This feature distinguishes them not only from consonants, which are all [-syllabic], but also from the glides /w/ and /j/, which appear in diphthongs and triphthongs. Vowels can appear either in stressed or unstressed positions. In Portuguese, as in other Romance languages, some stress oppositions are

Table 2-2. Articulatory Classification of Portuguese Vowels.

	Unrounded		Rounded	
	Front	to		Back
High	/i/			
Higher mid	/e/		/u/	
Lower mid		/ɛ/		/o/
Low		/a/		/ɔ/

Examples of Portuguese Vowels

Initial	Medial	Final
a /a/ <i>pato/patu/</i>	<i>batata/batata/</i>	<i>vaca/vaka/</i>
e /e/ <i>pêlo/pelu/</i>	<i>cabelo/kabelu/</i>	<i>*fome/fome/</i>
e /ɛ/ <i>pele/peli/</i>	<i>boneca/buneka/</i>	<i>café/kafe/</i>
i /i/ <i>mico/miku/</i>	<i>camisa/kamiza/</i>	<i>bule/buli/</i>
o /o/ <i>bolo/bolu/</i>	<i>tijolo/tiʒolu/</i>	<i>*tenho/tej ñ o/</i>
o /ɔ/ <i>móto/mɔtu/</i>	<i>maróla/marɔla/</i>	<i>mocotó/mocotɔ/</i>
u /u/ <i>luva/luva/</i>	<i>coluna/coluna/</i>	<i>tatu/tatu/</i>

* The vowel /e/ is frequently pronounced as /i/ in final position and the vowel /o/ is frequently pronounced as /u/ in final position. Only if the /e/ and the /o/ are followed by an /r/ or /s/, the original characteristic sound will be preserved (e.g., *morrer, comer, calor, mês, pôs*; /moReɾ/, /kumeɾ/, /kaLoɾ/, /meɾ/, /poɾ/).

neutralized under weak stress, and the vowel inventory consequently is reduced. Examples of Portuguese vowels in common words are presented in Table 2-2.

Diphthongs and triphthongs

Besides the single vowel nuclei described above, Portuguese has a rich variety of complex syllable nuclei, formed by a vowel phone accompanied by one or two glides. Phonetically, a glide is produced by a movement of the tongue toward or away from the area of articulation of one of the high vowels /i/ or /u/. Such a complex nucleus is a rising diphthong (Table 2-3) if the glide is followed by a vowel, as in *quatro* /'kwatru/, or a falling diphthong if the glide follows the vowel as is *pai* /paj/. If two glides are involved, the syllable nucleus is a triphthong as in the last syllable of *Paraguai* /para 'gwaj/.

Nasalization

Three types of vowel nasalization occur in Portuguese (Table 2-4). First, there are nasalized vowels following nasal consonants in the same syllable, in words like *doma* /'dôma/ or *boina* /'bôjna/. Second, there are nasalized vowels also in syllable-final position but adjacent to a nonnasal consonant in the following syllable. In such cases, standard orthography represents the nasalized nucleus as a vowel followed by a nasal consonant *campo* /kɤ pu/, *canto* /kɤ tu/. The third and final case is that of nasalized syllable nuclei in word-final position. These are pronounced in a manner similar to the second case; that is, as a sequence of a simple or complex nucleus followed by an underlying /n/, as in the

Table 2-3. Examples of Portuguese diphthongs and triphthongs.

Rising Diphthongs

ui	/wi/	saguí	iu	/ju/	miúdo
ue	/we/	dueto	ie	/je/	piedade
ue	/we/	cueca	ie	/je/	viéla
ua	/wa/	suave	ia	/ja/	quiabo
uo	/wɔ/	qüota	io	/jɔ/	idióta
uo	/wo/	qüociente	io	/jo/	piôlho

Falling Diphthongs.

iu	/iw/	faliu	ul	/uw/	pulga
ei	/ej/	sei	ui	/uj/	Rui
eu	/ew/	seu	oi	/oj/	foi
ei	/ei/	réis	ou	/ow/	sou
eu	/ew/	véu	oi	/ɔj/	dói
ai	/aj/	pai	ou	/ɔw/	sol
au	/aw/	mau			

Triphthongs

uai	/waj/	quais	iai	/jaɪ/	fiais
uei	/wej/	suei	iei	/jeɪ/	gui ei
uou	/wow/	suôu	iou	/jow/	guiou
uiu	/wiw/	ruiu			

Table 2-4. Nasal vowels in Portuguese.

Syllabic Nucleus			Word-final Position	
i	fino	/ˈfĩnu/	fim	/fĩ/
e	pêna	/ˈpɛ̃na/	tem	/tɛ̃j/
a	lâma	/ˈlɐ̃ma/	lã	/lɐ̃/
o	tôma	/ˈtõma/	som	/sõ/
u	fundo	/ˈfũdu/	um	/ũ/
ai	amãina	/aˈmɐ̃jna/	mãe	/mɐ̃j/
ei	rêino	/ˈRɛ̃jnu/	sem	/sɛ̃j/
oi	acôima	/aˈkõjma/	põe	/põj/
ui	arruina	/aˈRũjna/	ruim	/Rũj/

words *fim* and *ruim*. These two words are pronounced as /fĩn/ and /Ru ĩ n/, respectively, although orthographically they appear to end with a vowel followed by /m/.

Consonants

The Portuguese consonant system has been variously described as including from 16 to 21 distinctive units. This variation is due to competing interpretations of the phonological status of /l/, /n/, /r/ (the "double" or "strong" ɾ in words like *roupa*, *carro*, and *honra*), and the glides /j/ and /w/. In this study the figure of 19 consonant phonemes has been adopted, with /l/, /n/, and /r/ considered as independent phonological units, and the glides /j/ and /w/ as positional variants of the high vowels /i/ and /u/.

The description of the consonants takes into account two broad parameters: manner and place (or area) of articulation. Each contrast in place and manner corresponds to a feature common to a group of consonants.

Manner of articulation

Continuant vs. occlusive. Continuant sounds, such as /s/, /t/, /R/, are articulated without interruption of the flow of air. If the articulators form an obstacle to air flow, the consonant is an occlusive, such as /p/, /d/, /k/.

Nasal vs. oral. Nasal consonants are articulated with the velum lowered, so that the air enters the nasal cavity through the nasopharynx. If the velum is raised, the sound is oral.

Sonorant. This feature refers to the possibility of spontaneous voicing taking place during the articulation of a sound, and it is shared by vowels, glides, and certain consonants such as /l/ and /r/.

Lateral. In the articulation of lateral sounds, the air flows around the sides of the obstruction in the oral cavity as in /l/ and /L/.

Vibrant. This feature refers to sounds produced by vibration of the tongue. In Portuguese it applies to only two sounds, the flapped /r/ of *cara* /'kara/ and the "double r" of *carro* /'kaRu/. In one of its predominant phonetic manifestations, the /R/ is produced as an alveolar trill /R/, but variations are common.

Voicing. Depending on whether or not the vocal folds vibrate, sounds are classified as [+voiced] or [-voiced]. Those in which the vocal folds vibrate are [+voiced], e.g., /b/, /d/, /v/. Examples of [-voiced] consonants include /p/, /t/, and /f/.

Place of articulation

As can be seen in Figure 2-1, six places of articulation are relevant in Portuguese. Each of these is described briefly below.

Bilabial. In this manner of articulation the articulators are the lips, which act together to block the airflow, as in /b/, /p/, and /m/.

Labiodental. The upper front teeth form an obstacle to airflow as they contact the lower lip, as in /v/ and /f/.

Apicodental. The apex of the tongue touches the inner face of the front teeth, as in /t/ and /d/.

Portuguese Consonants	Bi-labial		Labio-Dental		Dental/Alveolar		Alveo-Palatal	Palatal	Velar	
Stop (Plosive)	p	b			t	d			k	g
Nasal		m				n	ɲ			
Fricative			f	v	s	z	ʃ		(x)	
Affricate							tʃ dʒ			
Lateral						n	L*		(R)	
Vibrants						r	R			

* /L/ has been used in figures and text to represent the sound /ʎ/, because its symbol is not available in this font.

Figure 2-1. Places and manners of articulation of Portuguese consonants.

Laminoalveolar. The blade of the tongue is placed against the alveolar ridge, as in /l/, /n/, /s/, /z/.

Palatal. The pre-dorsum of the tongue touches the hard palate, as in /L/.

Dorsovelar. The dorsum of the tongue touches the velum, blocking the airflow, as in /k/ and /g/.

Phonetic realization of consonants

Like the vowels, the consonant phonemes are affected, in varying degrees, by the phonetic environments in which they occur. The following is a list of some important variants of their phonetic realizations.

1. The /d/ and /t/ are palatalized before /i/ as in *dia* /dʒja/, and *tia* /tʃja/. In such cases, palatization may be described as resulting from a change in the value of the feature [anterior].
2. The /s/ becomes voiced in syllable-final position before a voiced consonant or vowel, as in *as duas* /az'dwas/, *as armas* /a'zarmas/, and it remains voiceless if followed by a voiceless consonant or pause, as in *este* /'estʃi/, *duas* /'dwas/. The voicing rule applies regularly in syllable-final position, generating a voiced fricative /z/, as in *desde* /'dezdzj/, as well as in word final position, if the next word begins with a voiced consonant: *os dois* /uz'dojs/.
3. The /r/ is a voiced apicoalveolar flap, as in *caro* /'karu/. In final position, it is maintained only in educated speech and slow, deliberate styles; otherwise it is greatly reduced, devoiced, or dropped altogether, as in *falar*, /fa'lar/.

/fa 'laʔ/, /fa 'la/. If final /ʔ/ is followed by a word beginning with a vowel, the /ʔ/, if pronounced, links with that vowel, forming a new syllable—*falar alguna coisa* /fa 'laraw 'gumakojza/. Some speakers use either /ʔ/ or /x/ in final position: *amor* /a 'mor/, /a 'mox/. In some rural speech, /ʔ/ has a palatal retroflex realization very similar to that of English postvocalic /ʔ/—*carpa* /'karpa/.

5. The /R/, which corresponds to an alveolar trill, has been used above to represent the so-called "double r." In fact, this phoneme has several different phonetic renderings, namely:
 - a. /ʔ/ voiced apicoalveolar trill,
/ʔ/ voiceless apicoalveolar trill,
 - b. /ʃ/ voiced alveopalatal fricative, slightly retroflexed,
/ʃ/ voiceless alveopalatal fricative, slightly retroflexed,
 - c. /x/ voiceless velar fricative,
 - d. /R/ voiceless uvular trill, and
 - e. /h/ voiceless glottal fricative.

All of these variants are regionally distributed allophones of the same phoneme, /R/. However, there is a noticeable amount of overlapping, so they are found in free variation in the same dialect or even in the speech of the same individual (Azevedo, 1981). The distinctive contrast between /ʔ/ and /R/ is maintained only in intervocalic position, as in *caro* vs. *carro* /'karu/ vs. /'kaRu/. Elsewhere, /R/ occurs

in word initial position or after a consonant (*Roberto, honra, Israel, guelra*; /Ro' berto/, /' ɔ Ra/, /is 'Raew/, /gɛw 'Ra/).

Syllable Type and Composition

The simplest syllable type in Portuguese contains only one vowel (e.g., *há* /'a/). If the nucleus is a diphthong, one of the vowels must be both [+high] and [-stressed] and articulated as a phonetic glide (e.g., *oi* /oj/). In Table 2-5 the syllable nuclei are represented by V and different consonants by C.

In Portuguese, not all consonants occur in every position. The restrictions of occurrence are best understood if single consonants and clusters are considered separately. Table 2-6 illustrates the positions within words in which consonant singletons can occur in Portuguese.

The number of possible consonant sequences in Portuguese is limited, and the ones that hold the most interest are those that form cohesive clusters within the same syllable. In clusters of the general type CC, the consonants are necessarily different from each other; there are no sequences of identical consonants in Portuguese. The first consonant must be a nonnasal stop (/p/, /b/, /t/, /d/, /k/, or /g/) or a labiodental fricative (/f/ or /v/), and the other can be only the anterior lateral /l/ or the flap /ɾ/.

There are some co-occurrence restrictions for clusters (Table 2-7). First, there are no /dl/ clusters, except marginally in foreign lexical items and

Table 2-5. Syllabic types of Portuguese.

V	há
VC	ás
CV	dá
CVC	das
CCV	prá
CCVC	cruz
CCVCC	trâns

Table 2-6. Distribution of Portuguese Consonants.

	Word Initial	Medial	Syllable Final	Word Final
/p/	pato	capa		
/b/	bata	cabo		
/t/	toca	mato		
/d/	data	cada		
/k/	cata	laca		
/g/	gato	toga		
/m/	mato	cama		
/n/	nata	cana	canto	sã, são
/ɲ/	nhonhô	minha		
/f/	faca	alfa		
/v/	vaca	alva		
/s/	saga	aço	deste	mas
/z/	zaga	vezo	desde	
/ʃ/	chaga	acho		
/j/	játo	haja		
/l/	lado	mala	alto	sal
/ʎ/	lhãma	rélho		
/r/	...	caro	farto	ser
/R/	rato	carro		

Table 2-7. Examples of Portuguese clusters.

	Initial	Medial
pl	planeta	réplica
pr	prazo	compra
bl	bloco	rublo
br	brinco	abraço
tl	tlintar	atlas
tr	...	atrás
dl	...	adleriano
dr	dragão	adro
kl	clarín	eclesiástico
kr	crime	recreio
gl	glosa	sigla
gr	grosélha	régra
fl	flauta	rifle
fr	francês	africano
vl	Vladimir	...
vr	...	lavra

derivatives, such as *Adler* and *adleriano*. Second, in initial position, /vr/ and /tl/ are very rare. Third, the cluster /vl/ appears initially only in the foreign name *Vladimir* and medially in borrowed words, such as the trademark *Revlon*.

Other non-cluster consonant sequences are not frequent in Portuguese (Table 2-8). The only frequent phonological consonant sequences in Portuguese are /ns/ and /nd/. Here, however, after nasalization of the preceding vowel, the nasal consonant /n/ is usually deleted, barely leaving a phonetic trace, as in the plurals *sons*, *bons* and the progressive form of verbs such as *nadando*.

Studies of Acquisition of Portuguese

Very little empirical research about the acquisition or disorders of phonology among Portuguese speaking children in Brazil has been reported. The need for such research and for the publication of methodologies for the practicing speech-language pathologist was recognized by Yavas, Hernandorena, and Lamprecht in their 1991 book, *Avaliação Fonológica da Criança - Reeducação e Terapia* (Phonological evaluation of children). Santini and Dyson (1995) also stressed the importance of such research in their article, "*Discussão sobre Metodologia de Pesquisa Relacionada a Área de Aquisição Fonológica*" (Discussion of methodological issues related to phonological acquisition). Yavas et al. (1991) prepared their manual to provide a method for phonological analysis as a clinical tool. They emphasized the relationship between theoretical phonological principles and practical therapy issues. Two important contributions of this manual are the presentation of an instrument for obtaining a sample of linguistic

Table 2-8. Consonant sequences in Portuguese.

	Initial(very rare)	Medial
/pt/	ptialína	rapto
/pn/	pneu	dispneia
/ps/	psicologia	decepção
/bd/	bdelio	abdicar
/bg/	...	Abgail
/bz/	...	abjeto
/bv/	...	óbvio
/bm/	...	abmigração
/bn/	...	abnegação
/bs/	...	absorver
/tm/	tmese	atmosfera
/dg/	...	Edgar
/dv/	...	adventista
/dm/	...	admitir
/dn/	...	abdominal
/ds/	...	adstringente
/dʒ/	Djalma	adjunto
/kt/	ctenideo	ectoplasma
/kn/	cnemio	técnico
/ks/	...	ficção
/kz/	czar	eczema
/gf/	...	Agfa
/gn/	gnômo	agnóstico
/ft/	ftaleína	aftóse

data (consonants) and the presentation of different theoretical and methodological bases for analyzing the data collected.

The clinical instrument described by Yavas et al. (1991) was first reported by Yavas (1988) in a pilot study of phonological acquisition in 72 Portuguese-speaking children between the ages of 2;4 and 4;4. This instrument consisted of five theme pictures used to elicit 120 words by spontaneous naming. The words elicited and the procedures for their elicitation and analysis were revised and presented more fully by Yavas et al. (1991).

In 1993, Lamprecht presented a study on the phonological acquisition of Portuguese in children aged 2;9 to 5;5. She stated that the majority of current studies of phonological development—normal or disordered—are based on the Natural Phonology Theory (Stampe, 1969, 1973). Lamprecht reported that in the last 10 years, 9 out of the 14 most important publications have been based on Stampe's model. Two others analyzed distinctive features, two were founded in generative phonology, and one on auto-segmental phonology. Because of this emphasis on natural phonology and because its application to Portuguese was not clear, Lamprecht (1993) conducted a longitudinal study describing the phonological acquisition of Portuguese based on natural phonology theory. She emphasized that such information is relevant, not only to enhance our knowledge about the normal parameters of Portuguese phonology for clinical speech therapy, but also as a data resource for educators in general.

Lamprecht included 12 children aged 2;9 to 5;5 in her study. The speech samples were collected using the five theme pictures proposed by Yavas et al. (1991) and described above. The data were analyzed using contrastive analysis and phonological processes analysis. Her findings indicated most phonological processes occurred less than 25% of the time by 4;2. The last processes to be suppressed were cluster reduction, fronting, devoicing, and deletion of liquids in the syllable final position within words.

Wertzner (1992) pointed out the lack of descriptions of the articulatory acquisition of Brazilian children. Her study of 56 children (equally divided between girls and boys) was intended to verify the use of phonological contrasts and phonological processes in children between 3;0 to 7;0, seen at the Health Center "Serviço de Pediatria do Centro de Saúde Escola Prof. Samuel B. Pessoa." All subjects were from the same "district" (Bairro do Butantã), and all were from a low socioeconomic status. Her specific research objectives were: (1) to describe the order of phoneme acquisition, the occurrence of phonological processes in the children's speech, and differences in the occurrence of phonological processes in the speech of the children and their mothers, (2) to verify the viability of using the Khan-Lewis (1986) analysis model to describe the use of phonological processes in Portuguese, and (3) to compare the first two objectives in terms of the imitation and naming situation. Only the first objective is of primary interest in the proposed study. Her results indicated some individual differences but a general agreement with previous literature. Plosives and nasals were acquired

first, followed by fricatives, and then liquids. In terms of place of articulation, labials preceded dentals/alveolars, which preceded palatals and velars. The lateral liquids were acquired before the non-lateral liquids. She hypothesized that the individual differences were due to different "strategies" used by the children. All phonological processes, with the exception of consonant sequence reduction, were suppressed by about 4:1 or 4:2. Consonant sequence reduction persisted until about 5:2.

Mota (1993) looked at the practical application of phonological theory with Portuguese-speaking children. She conducted a study to evaluate the efficacy of a therapy model based on phonological processes in the treatment of children with developmental phonological disorders. Three subjects were selected from the children who went to one university speech and hearing clinic in Brazil with the complaint of "speech problems." All three subjects were male, ages 6:2, 5:8, and 5:0. The subjects had been diagnosed as presenting developmental phonological disorders before being treated with the phonological remediation model selected (Hodson & Paden, 1986).

The subject selection was based on a speech-language and hearing evaluation that included: an interview with parents for a case history, a psychomotor evaluation, an orofacial exam, a language evaluation, an auditory discrimination test, and complementary exams as needed (e.g., ENT, hearing evaluation, neurological evaluation). The results from all exams except the phonological evaluation were within normal limits. The phonetic inventories of all

three subjects were almost totally complete before treatment. However, their contrastive phone systems showed the absence of important contrasts, which made their speech unintelligible at times.

The phonological treatment plan consisted of two cycles with re-evaluation after each cycle. Mota (1993) suggested that the results showed some improvement between the initial evaluation and the second re-evaluation. Although no information was given regarding length of treatment, the author said that:

The analysis of the results obtained with this study led me to a conclusion that supports the validity of the method used. The value of the model used could be seen in terms of the short time needed to obtain significant improvement in the phonological system of the subjects and, therefore, in their pronunciation, and also in the facilitation of the appearance of carry-over from the small amount of sounds trained. (Mota, 1993, p.49, translated by this author)

In 1994, Silvério et al. conducted a study to describe the occurrence of Portuguese phonemes in preschool children and to compare the phonological performance of children in private schools as opposed to public schools. The variables considered in their subject selection were: gender, age, and type of school attended. The study included 235 children, 117 from private schools and 118 from public schools. The subjects were almost equally distributed between males and females. Their ages ranged from 2:6 to 5:6 divided into three groups: 2:6 to 3:6, 3:6 to 4:6, 4:6 to 5:6. The testing procedure consisted of three parts: (1) spontaneous speech (with a set of questions), (2) picture naming (25 two-syllable words), and (3) word repetition (22 two-syllable words). All sounds were

tested in the initial position except for /L/, /r/, /n/, which were tested in the medial position. The /s/ and /t/ were tested in the word final position. The criteria for correct production (acquisition) by each child was one out of the three possible elicitations of a sound. Distorted productions were considered to be incorrect. According to the authors such a criterion shows that the child was capable of correct emission of the sound, but one cannot evaluate the systematic use of the sound.

According to Silverio et al. (1994) the analysis of the data collected showed that: (1) the phonemes were earlier than usually reported in the literature; (2) there is a difference between the two groups in terms of ages when phonemes occur, although the hierarchy of phonemes is preserved; and (3) most of the time, the phonemes were used by the children without distortions or substitutions from the start. The authors of the study suggested that the superior performance of the subjects from private schools was probably due to higher expectations for children among those in higher social economic (and cultural) levels.

Statement of the Problem

The Need for this Research

Phonological acquisition can be seen as an interesting topic that has fascinated researchers trying to solve the puzzle of how children learn to talk. The review of the literature presented above provides some examples of a large body of literature devoted to child phonology showing several different attempts to improve aspects of the investigation. It is safe to say that speech is an extremely

complex behavior that encompasses many variables, making the investigator's task an enormous one.

Although several different theoretical frameworks have been applied to data from children's speech in English, not much has been done in terms of evaluating the validity of those results when applied to other languages. In terms of Portuguese it can be seen that child phonology is an expanding area with several studies dating from 1992 to the present. In addition, most studies addressing the acquisition of Portuguese phonology have emphasized the need for the collection of more data in the area (Lamprecht, 1993; Silverio et al., 1994; Wertzner, 1992), and especially in the area of phonological disorders.

According to the last census, there are nearly 160 million people living in Brazil. Portuguese is the only language spoken in that country and no major dialects are found, except for small accent variations that do not affect meaning. This language was chosen for several different reasons. First, Portuguese operates differently than English; therefore, its study may provide cross-linguistic information on how the phonological system develops. Second, in the few studies found addressing the phonological acquisition of Portuguese (Hernandorena, 1993; Lamprecht, 1993; Silverio et al., 1994; Wertzner, 1992; Yavas, 1988) the need for further studies that would provide large scale normative data was pointed out. Finally, the area of phonological disorders, more specifically, the field of speech-language pathology has been trying to build a more theoretical basis to support and legitimize clinical findings. Therefore, the present study

proposed a detailed control of many of the methodological issues raised by previous researchers in the attempt to provide a collection of data about acquisition of phonology by Portuguese speaking children.

Purpose of Study

The general purpose of the study was to collect normative data on the acquisition of consonantal sounds of Portuguese. Samples were collected from normally developing children in Brazil. The data were be used to answer the following questions:

1. What percentage of each consonant was produced correctly by children at each age level?
2. What is the age of "customary production" for each sound?
3. What is the age of "acquisition" for each sound?
4. What is the age of "mastery" for each sound?

CHAPTER 3 METHODOLOGY

The purpose of this study was to collect normative data on the acquisition of the consonant sounds of Portuguese. These data were used to answer a number of questions about the ages and order of acquisition.

Subjects

The subjects included 192 monolingual, Portuguese-speaking children. Their ages ranged from 2:0 to 6:10 (years:months) in the following intervals:

2:0 to 2:4,

2:6 to 2:10,

3:0 to 3:4,

3:6 to 3:10,

4:0 to 4:4,

4:6 to 4:10,

5:0 to 5:10, and

6:0 to 6:10.

Twenty-four children were included in each of the eight groups. The ages and composition of each group can be seen in Table 3-1. Each age group was intended to include an equal number of girls and boys, although a few minor exceptions to this rule had to be made among the youngest groups.

Table 3-1. Distribution of subjects' ages (years:months) and gender (M=male, F=female) in each group.

Groups															
2:0		2:6		3:0		3:6		4:0		4:6		5:0		6:0	
Age	Gender	Age	Gender	Age	Gender	Age	Gender	Age	Gender	Age	Gender	Age	Gender	Age	Gender
2:0	M	2:6	M	3:0	M	3:6	F	4:0	F	4:6	M	5:0	F	6:0	M
2:0	M	2:6	F	3:0	F	3:6	M	4:0	F	4:6	F	5:0	F	6:0	F
2:0	M	2:6	F	3:0	F	3:6	F	4:0	F	4:6	F	5:0	F	6:0	M
2:0	F	2:6	M	3:0	F	3:8	F	4:0	F	4:6	M	5:1	M	6:0	F
2:0	F	2:6	F	3:0	F	3:8	F	4:1	F	4:7	M	5:1	M	6:0	F
2:0	M	2:6	F	3:2	F	3:8	M	4:1	M	4:7	F	5:3	F	6:0	M
2:2	F	2:6	F	3:2	M	3:8	M	4:2	M	4:8	M	5:3	F	6:2	M
2:2	M	2:6	M	3:2	M	3:9	F	4:2	F	4:8	F	5:4	F	6:3	M
2:2	F	2:6	F	3:2	F	3:9	M	4:2	F	4:8	M	5:4	M	6:3	F
2:2	M	2:7	M	3:2	M	3:9	F	4:2	M	4:8	F	5:4	F	6:4	F
2:2	F	2:8	M	3:2	F	3:10	M	4:2	M	4:8	F	5:4	F	6:5	M
2:2	M	2:8	F	3:2	M	3:10	M	4:2	F	4:8	F	5:4	M	6:6	M
2:2	F	2:8	F	3:3	F	3:10	F	4:2	M	4:8	M	5:5	M	6:6	F
2:2	M	2:8	F	3:3	F	3:10	F	4:2	F	4:8	M	5:5	F	6:6	F
2:2	F	2:8	F	3:4	M	3:10	M	4:2	M	4:8	M	5:5	M	6:7	F
2:3	F	2:9	M	3:4	M	3:10	F	4:2	M	4:8	F	5:6	M	6:7	M
2:3	F	2:10	M	3:4	M	3:10	M	4:3	F	4:9	F	5:7	F	6:7	F
2:4	F	2:10	F	3:4	F	3:10	M	4:3	M	4:9	M	5:7	M	6:7	F
2:4	M	2:10	M	3:4	M	3:10	F	4:3	F	4:9	F	5:9	M	6:8	M
2:4	F	2:10	F	3:4	F	3:10	M	4:3	F	4:9	M	5:10	M	6:8	F
2:4	F	2:10	F	3:4	M	3:10	M	4:4	M	4:10	M	5:10	M	6:8	M
2:4	M	2:10	M	3:4	F	3:10	M	4:4	M	4:10	F	5:10	F	6:9	M
2:4	M	2:10	F	3:4	M	3:10	F	4:4	M	4:10	M	5:10	M	6:9	F
2:4	F	2:10	M	3:4	F	3:10	F	4:4	M	4:10	F	5:10	F	6:9	M

An oro-facial screening examination was conducted to exclude subjects who showed any abnormalities in the speech mechanism that could interfere with speech production and/or language development. No child considered as a subject exhibited such physical abnormality.

The selection of subjects was intended to represent the socioeconomic status of the population of the State of São Paulo, Brazil. An attempt to mirror the entire population was made by testing children from both one public and two private schools.

The Assessment Instrument

Stimuli

A picture-naming test developed by Yavas et al. (1991) was used to collect the data. The test consists of five theme pictures (*Vehicles, Living Room, Bath Room, Kitchen, and Zoo*) used to elicit spontaneous single word responses. The pictures can be seen in Appendix A, and the word lists in Table 3-2. The five theme pictures encouraged the elicitation of 125 words, 97 basic words plus 28 optional words shown in italics. The words sampled are commonly present in children above 3 years of age, test the target sounds necessary, and are easily represented through drawings (Yavas et al., 1991). The numbers of each sound tested in each position are presented in Table 3-3. According to Yavas et al., the words chosen had the following phonological criteria: (1) a balanced

Table 3-2. List of words targeted by each picture.

Folha de Gravação				
Nome:				Data:
Idade:				
Zoo	Kitchen	Living Room	Bath Room	Vehicles
borboleta	abacaxi	brinquedo	banquinho	andar
cachorro	açúcar	cruz	blusa	bicicleta
cobra	café	dinheiro	bolso	brincar
comer	estrela	disco	braço	carro
dois	feijão	globo	calça	crianças
dragão	fogão	guarda	camisa	dizer
flôr	frio	chuva	chave	dirigir
floresta	fruta	igreja	chinelos	estrada
grama	garrafa	jornal	dedo	frente
grande	geladeira	lápiz	dente	fumaça
latir	janela	livro	escovar	microfone
olhar	prato	martelo	nariz	nadar
passarinho	soprar	mesa	pescoço	nuvem
pedra	vela	palhaço	relógio	placa
peixe	vidro	planta	sabonete	tia/tio
pular	<i>banana</i>	prego	toalha	tocar
rabo	<i>bolo</i>	quadro	esperar	trator
sol	<i>fogo</i>	rádio	<i>armário</i>	trem
tigre	<i>ovo</i>	tapete	<i>azulejos</i>	<i>âncora</i>
verde	<i>tampa</i>	televisão	<i>cabelo</i>	<i>chaminé</i>
zebra		tesoura	<i>cano</i>	<i>navio</i>
zoológico		<i>antena</i>	<i>espelho</i>	<i>roda</i>
orelha		<i>botão</i>	<i>menino</i>	<i>trilho</i>
voar		<i>estante</i>	<i>perna</i>	<i>sino</i>
		<i>franja</i>	<i>porta</i>	
		<i>poltrona</i>	<i>saia</i>	
		<i>telhado</i>	<i>sapato</i>	
			<i>torneira</i>	

Table 3-3. Distribution of consonants by position. SIWI=syllable-initial, word-initial; SIWW=syllable-initial, within-word; SFWW=syllable-final, within-word; SFWF=syllable-final, word-final.

	SIWI	SIWW	SFWW	SFWF	Total per sound
b	10	7			17
p	11	4			15
d	4	22			26
t	6	11			17
g	5	6			11
k	10	13			23
m	4	4			8
n	4	10	12		26
ɲ		3			3
v	4	8			12
f	9	3			12
z	2	5			7
s	5	10	8	5	28
ʃ	2	3			5
ʒ	3	5			8
tʃ	3	5			8
dʒ	3	3			6
l		5			5
l	3	12			15
r		9	6	3	18
x	4	3			7
Total per position	92	151	26	8	277

representation of the target phonological system of Portuguese (that is, the adults' phonological system); (2) more than one occurrence of each possible different target; and 3) opportunities for the sounds to occur in different positions within the words and in words with differing syllable structure and number of syllables. Four syllable and word structures were considered: SIWI (syllable-initial, word-initial), SIWW (syllable-initial, within word), SFWW (syllable-final, within word), and SFWF (syllable-final, word-final).

The five theme pictures allowed the elicitation of 125 words along with the opportunity to elicit more data in the form of narratives and descriptions. According to Yavas et al., the set of pictures allows the elicitation of a representative sample because it is not limited to one representative of each target sound. Contrary to most articulation tests, this test provides at least three possible occurrences of each consonant sound of Portuguese in all positions. The only instances where the principle of three occurrences in all positions is not met are described below.

/z/ SIWI. The Portuguese vocabulary has few examples of /z/ in the word initial position. The two words included in the test (*zebra* and *zoológico*—*zebra* and *zoo*) can be easily produced by children as young as 3 years old.

/tʃ/, /dʒ/ SIWI and SIWW. Although these two sounds (affricates) are normal allophones of /t/ and /d/ in most variants of Portuguese, they were included in order to provide a more complete picture of child phonology. The pictures elicited only two words for each of the two sounds in SIWI because a

third example is expected to occur naturally when the child says *tio* and/or *tio*, referring to the examiner, and some forms of the verb *dizer*, as *digo* or *disse* (*to say*).

/l/ SFWW and SFWF. Only two words were provided for each of the two syllable-final possibilities. Yavas et al. suggested that, because the /l/ is produced as a semi-vowel in final position, the two examples provided are enough for the this non-consonantal sound.

Clusters. Most clusters were elicited in only one example, and some clusters are not even present. This decision was made based upon the rationale of presenting an adequate vocabulary for children. Even the limited set of word containing clusters that are included may not be totally appropriate for young children. For example, the words: *vidro, dragão, floresta, globo, prego, igreja, cruz, poltrona, trator, estrada, trilho, planta* (*glass, dragon, forest, globe, nail, church, couch, tractor, road, rail road, plant*) may not occur spontaneously in the speech of young children. In addition, it has been observed that even older children who produce these words, often reduce the clusters. The words *fruta* and *brinquedo* (*fruit* and *toy*) seemed easy but are difficult to elicit because they refer to collective nouns and not to specific names. It should also be noted that the number of possible consonant sequences in Portuguese is limited, and clusters do not occur often.

Some words that were not represented in the pictures needed to be elicited by a question. These words are: *dizer, dois, frente, frio, grande, latir, microfone,*

soprar, tia/tio, verde, zoológico (to say, two, front, cold, big, to bark, microphone, to blow, aunt, green, zoo). Some words to be elicited were directly related to a specific picture; for example, *latir* (to bark) appeared in the list of words for the zoo picture because that is where the *dog* is represented. Other words that are not directly related to any one picture were distributed between the five drawings so that no word list would carry more or less words to be elicited verbally. However, the words that were not directly represented in the drawings could be easily integrated in the exam as part of the conversation. These are *microfone, dizer, tia/tio*, and *frente* (microphone, to say, colloquial name for Ms/Mr, and in front of).

Procedure

The test was administered to each child individually in a quiet room. If the child refused to stay alone with the examiner, one adult was allowed to stay with the child. When testing the youngest children, the class teacher or the aid usually stayed with the child and helped the examiner. The exam was tape recorded using a lapel microphone clipped to the child's clothing, approximately six to eight inches from the child's mouth. A total of thirty-five 90-minute tapes were used for the recordings.

To administer the test the examiner placed each of the five theme pictures one at a time in front of the child. The child was instructed to look at the picture and then to tell all that he/she could about it. The examiner followed the child's productions using an alphabetical list of all the words to be elicited by each picture. The examiner repeated the responses of very young children who

appeared difficult to understand to ensure that they would be recognized on the tape recording. A check mark was placed on the response form beside each word named by the child, regardless of the accuracy of the articulation. The words that were optional appeared in italics and were not prompted if not produced spontaneously. When a child did not produce all of the obligatory words, the examiner used delayed imitation with some form of the question: "*This is a cabinet (target word) in the bathroom (picture name)? Can you tell me that?*" In cases where delayed imitation did not elicit the desired word, direct imitation was used. The child was sometimes praised and/or encouraged to name the pictures but was not reinforced for correct productions.

Duration of the Exam

The exam was performed in 20 to 30 minutes with most children. For the younger children, a much longer session often was needed, and three subjects were tested in two sessions to assure the validity and reliability of results.

Test Environment

The room used for the data collection was a quiet room away from street noise or conversational background noise. The examiner and the child were usually sitting at the table, although the younger children were often tested on the floor.

Examiners

Three examiners, including the author of this research, collected the data. All three examiners were speech-language pathologists with several years of

experience. The author trained the examiners to administer and record the exam and provided a written protocol for them to follow to ensure a standard procedure and to clarify possible questions. In fact, the author tested approximately 60-70% of the children herself.

Tape Recording Equipment and Procedure

The exam was recorded using a Marantz tape recorder model CH 221 with an external lapel microphone. The entire exam session was recorded because words used in the greeting and the test recording were analyzed as a part of the sample (i.e., *tia*, a colloquial name for an adult female; *microfone*, *microphone*; *dizer*, *to say*). Each taped sample was checked immediately after recording to ensure that it was audible and had a minimum of extraneous noise. None of the samples needed to be discarded for any technical reason.

Transcription

Narrow transcription was used to transcribe the children's productions of the target sound. Approximately 30% of the audiotape material was transcribed by two trained and experienced transcribers, the author and supervisor, using the consensus procedure outlined by Shriberg et al. (1984). After transcription of each utterance, the two versions were compared. Segments on which the transcribers agreed were accepted and entered on the data collection sheet mentioned above. Disagreements were resolved by replaying the utterance a maximum of three times with each transcriber attempting to hear the other's transcription as well as

trying to confirm their own transcription. The remaining 70% were transcribed by the author alone with spot checks by the supervisor.

To examine the reliability of transcription, 10% of the samples, one subject selected randomly from each group were transcribed independently by the two listeners. A program for computing reliability using relative weights for different types of disagreement was used. This program, which is part of the Logical International Phonetics Program -LIPP (Oller & Delgado, 1990) was used for the analysis of the data and for comparison of the two transcribed versions sound by sound. The rule set for this program was originally included in the LIPP but several modifications were made for the sounds of Portuguese.

Data Entry and Tabulation

After transcribing each sample, the data were entered on a data collection sheet (Appendix B) and later entered into the computer using the LIPP (Oller & Delgado, 1990). This program allows entry of data in IPA symbols with any desired set of diacritic mark. The expected standard form of each target sound was entered in the LIPP program ahead of time. For each sound tested, a set of rules compares the child's production with the acceptable response to determine whether or not the response can be counted as "correct."

Validity of the Test

In order to account for word elicitation, a pilot study conducted by Yavas et al. (1991) tested 40 children between 3 and 4 years of age. The results showed that most basic words reached at least 50% adequate elicitation. The basic words

that did not meet the 50% criteria were: *zoológico, zebra, globo, floresta, planta, microfone, placa, fruta, cruz, claro, igreja, and dragão* (Zoo, zebra, globe, forest, plant, microphone, sign, fruit, cross, bright, church, and dragon). Those words were maintained on the test to provide a significant phonological sample as other suitable words could not be found (Yavas et al., 1991). In terms of content validity, this is implicit in this type of study when all sounds of the language in all positions are included. To examine construct validity, the extent to which accuracy of the sounds on the test reflects increases due to increasing age were observed as a part of the overall purpose of the study.

Presentation of the Data

To determine the percentages of each consonant sound produced correctly at each age level, the data were tabulated by age level and by sex, with an entry made for each sound. The four positions were treated independently to control for the position factor. The percentages of correct productions at each age level in each position (e.g., SIWI) was computed separately from the percentages in any of the other three possible positions (SIWW, SFWW, and SFWF).

CHAPTER 4

RESULTS

This study was undertaken to answer four questions. The results intended to answer the first question will be presented first under several headings. The remaining three questions will be combined, and the results intended to answer these three questions will be presented together.

Question 1. What percentage of each consonant was produced correctly by children at each age level?

The percentages of correct production at each age level for all sounds combined can be seen in Figure 4-1. It should be noted that the youngest subjects sampled in this research were 2 years old, which suggests that phonological acquisition had started before the child was tested. Over 50% of the consonants attempted were already produced correctly by the youngest group. It can be seen that between the first group (2:0) and the second group (2:6), the most dramatic increase in accuracy was made, from 51% to 67%. The increases between each of the other groups ranged from 2% to 9%. By 4:0 phonological acquisition was essentially complete. Between the ages of 4:0 and 6:0, there is a two year time frame during which the change was very subtle. By 6:0, 97% of the consonants were correct.

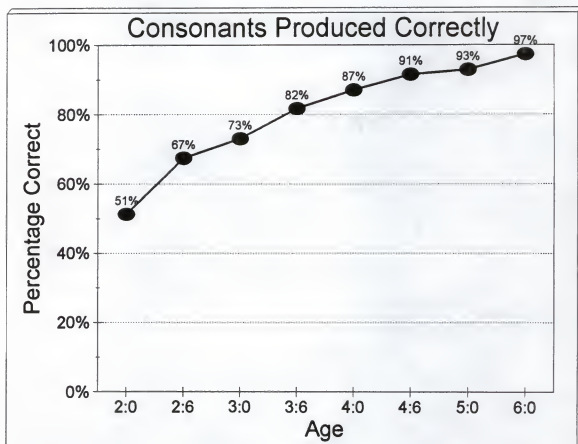


Figure 4-1. Overall percentage of consonants produced correctly by each group.

SIWI, Syllable-Initial, Word-Initial

The percentages of each consonant produced correctly in the SIWI position by all groups can be seen in Table 4-1. The results for each group are illustrated separately on Figures 4-2 through 4-9. It can be seen that the nasals and the stops were produced correctly earlier than the fricatives and liquids, with the exception of the two fricatives /f/ and /v/, which were acquired earlier than the others. A tendency to produce voiceless consonants more accurately than voiced consonants was observed across all age groups. The youngest groups showed a marked increase in the percentage of correct production for both nasals and stops between 2:0 and 2:6 years of age. The liquids were produced with greater than 80% accuracy at age 3:0 in SIWI position. The fricatives /s, z, ʃ, ʒ/ were the least accurate sounds. The affricates, especially /tʃ/, were produced correctly earlier than the fricatives, at age 3:0.

SIWW, Syllable-Initial, Within-Word

The percentages of each consonant produced correctly in the SIWW position by all groups can be seen in Table 4-2. The results for each group are illustrated separately on Figures 4-10 through 4-17. For syllable-initial within-word (SIWW) position it can be seen that the nasals and stops were again produced earlier than the fricatives and the liquids, with the exception of /f/ and /v/, which were acquired earlier. It should be noted that three nasals were possible in this position as opposed to SIWI, where only two occur. However, this did not change the percentage of correct occurrence of nasals in relation with the SIWI position.

Table 4-1. Percentage of each consonant produced correctly in the SIWI position in each age group.

	Age Groups							
	2:0	2:6	3:0	3:6	4:0	4:6	5:0	6:0
b	46.85%	70.72%	86.88%	93.22%	94.89%	97.91%	96.17%	100.00%
p	82.88%	96.57%	96.14%	98.35%	99.19%	99.60%	99.21%	99.61%
d	42.31%	80.33%	80.68%	96.70%	96.74%	96.81%	95.79%	100.00%
t	78.22%	87.38%	96.21%	95.71%	97.20%	98.58%	99.29%	100.00%
g	25.93%	66.22%	71.96%	89.17%	94.96%	95.76%	94.07%	99.17%
k	71.92%	92.98%	92.44%	98.73%	99.15%	100.84%	100.00%	100.00%
m	75.93%	87.50%	95.71%	97.50%	98.75%	96.55%	100.00%	100.00%
n	58.00%	78.95%	90.41%	85.92%	87.84%	88.46%	96.10%	95.29%
v	31.43%	63.46%	66.67%	85.56%	92.22%	91.40%	95.79%	98.95%
f	67.86%	93.38%	94.41%	98.96%	99.48%	98.45%	100.00%	100.00%
z	29.41%	60.00%	37.50%	57.78%	70.83%	75.56%	72.92%	97.92%
s	25.93%	31.75%	40.43%	61.05%	69.00%	84.21%	93.27%	90.29%
ʃ	13.79%	17.95%	45.83%	66.67%	87.23%	89.58%	93.75%	97.96%
ʒ	12.96%	14.52%	25.35%	47.89%	44.44%	71.83%	83.10%	95.83%
tʃ	40.43%	78.18%	80.56%	89.71%	95.71%	98.55%	94.44%	100.00%
dʒ	14.29%	39.13%	52.46%	65.22%	82.86%	87.32%	94.20%	100.00%
l	31.25%	79.55%	86.36%	87.14%	98.59%	100.00%	98.59%	98.61%
r	15.91%	37.93%	80.82%	91.25%	96.00%	98.73%	98.77%	98.73%
All Sounds	40.28%	61.92%	69.52%	79.29%	84.48%	87.90%	89.76%	93.28%

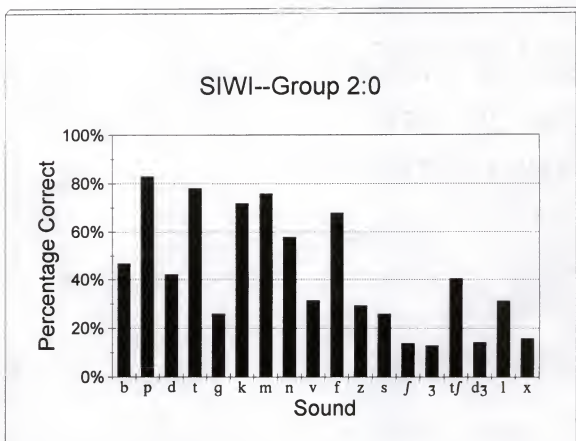


Figure 4-2. Percentages of accuracy of each consonant in the SIWI position for Group 2:0.

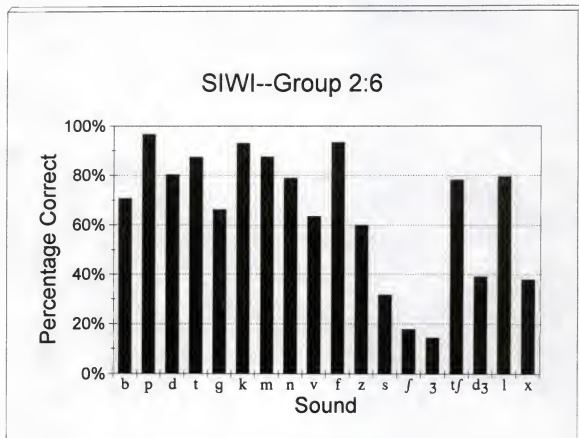


Figure 4-3. Percentages of accuracy of each consonant in the SIWI position for Group 2:6.

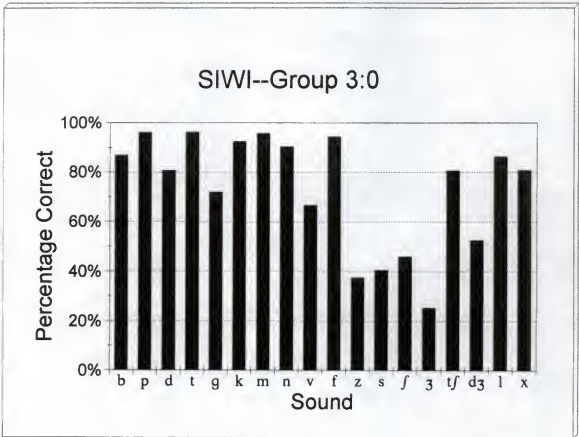


Figure 4-4. Percentages of accuracy of each consonant in the SIWI position for Group 3:0.

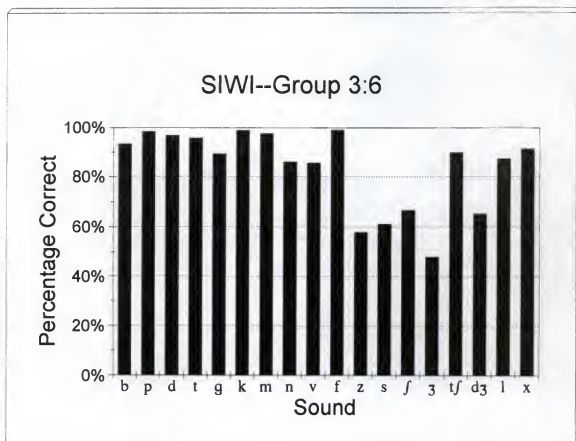


Figure 4-5. Percentages of accuracy of each consonant in the SIWI position for Group 3:6.

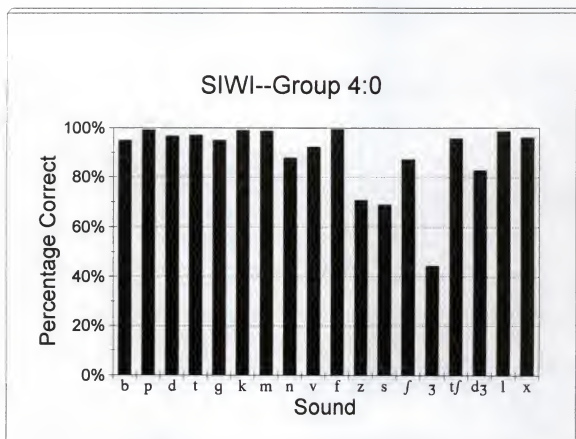


Figure 4-6. Percentages of accuracy of each consonant in the SIWI position for Group 4:0.

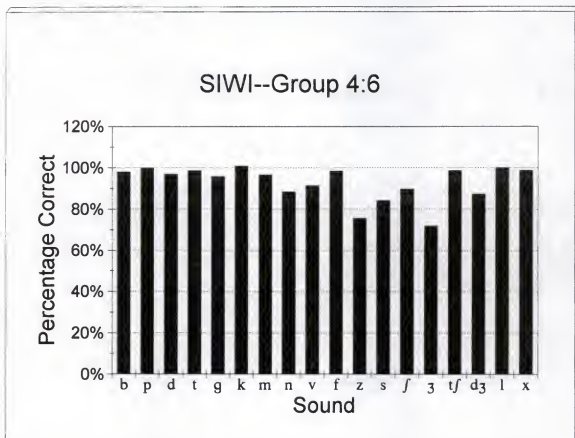


Figure 4-7. Percentages of accuracy of each consonant in the SIWI position for Group 4:6.

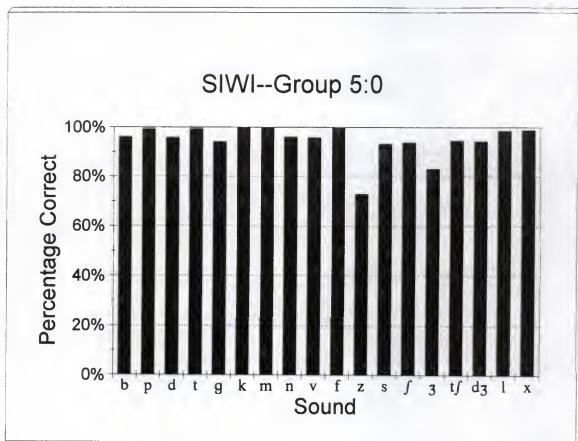


Figure 4-8. Percentages of accuracy of each consonant in the SIWI position for Group 5:0.

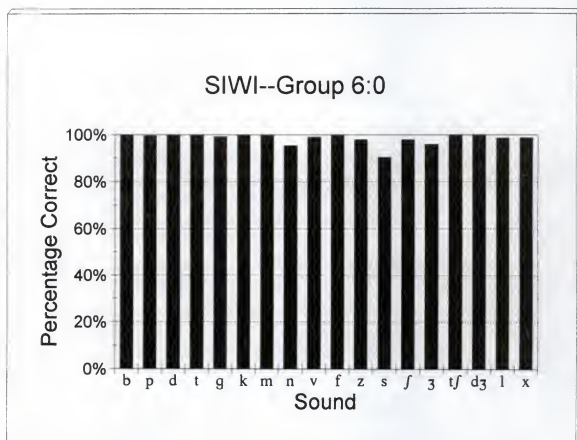


Figure 4-9. Percentages of accuracy of each consonant in the SIWI position for Group 6:0.

Table 4-2. Percentage of each consonant produced correctly in the SIWW position in each age group.

	Age Groups							
	2:0	2:6	3:0	3:6	4:0	4:6	5:0	6:0
b	51.09%	78.23%	77.02%	91.57%	94.01%	96.39%	94.61%	98.81%
p	94.12%	100.00%	51.09%	100.00%	100.00%	96.51%	100.00%	100.00%
d	51.28%	56.46%	69.15%	76.41%	83.95%	82.28%	88.62%	93.90%
t	94.22%	100.00%	99.15%	99.59%	97.57%	99.60%	98.81%	100.00%
g	48.15%	61.11%	67.24%	82.11%	90.91%	94.26%	91.20%	98.40%
k	75.57%	97.87%	94.72%	98.64%	99.03%	99.67%	98.69%	99.68%
m	91.43%	94.34%	96.30%	100.00%	100.00%	98.95%	98.95%	100.00%
n	87.23%	94.48%	98.97%	98.56%	98.08%	97.67%	99.09%	100.00%
v	47.71%	65.32%	65.22%	81.17%	89.10%	93.98%	90.91%	97.75%
f	82.93%	96.30%	96.97%	98.51%	100.00%	100.00%	98.55%	100.00%
z	36.25%	40.38%	42.02%	52.10%	66.12%	75.00%	83.19%	92.50%
s	30.15%	33.95%	47.56%	58.72%	58.58%	80.17%	85.23%	91.25%
ʃ	18.33%	28.17%	54.79%	73.97%	86.11%	90.28%	91.67%	98.61%
ʒ	16.00%	21.21%	28.16%	35.65%	58.47%	69.83%	76.47%	87.50%
tʃ	53.57%	78.67%	79.82%	88.70%	93.50%	97.44%	95.80%	100.00%
dʒ	17.86%	26.53%	47.69%	46.38%	67.61%	72.22%	81.94%	92.96%
l	52.71%	87.50%	85.87%	85.00%	96.83%	100.00%	96.15%	98.95%
x	35.59%	50.00%	83.33%	90.28%	92.86%	100.00%	100.00%	100.00%
All Sounds	54.68%	67.25%	71.39%	80.96%	87.37%	91.35%	92.77%	97.24%

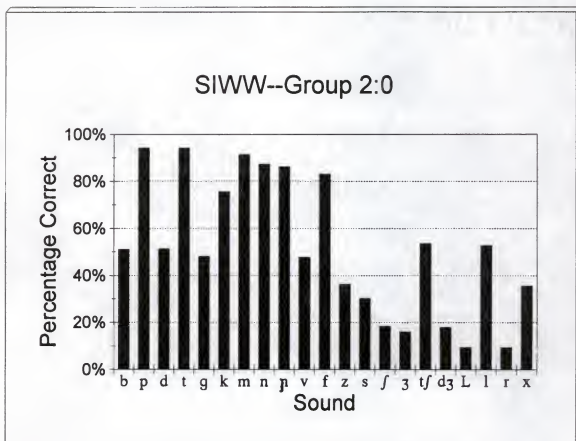


Figure 4-10. Percentages of accuracy of each consonant in the SIWW position for Group 2:0.

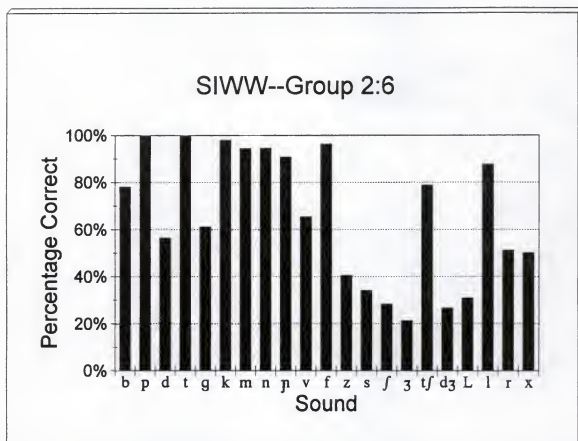


Figure 4-11. Percentages of accuracy of each consonant in the SIWW position for Group 2:6.

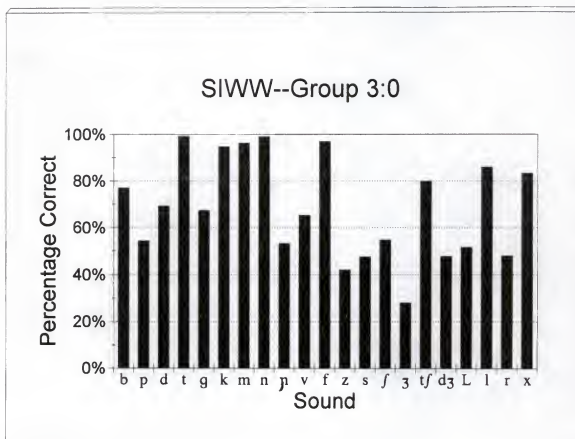


Figure 4-12. Percentages of accuracy of each consonant in the SIWW position for Group 3:0.

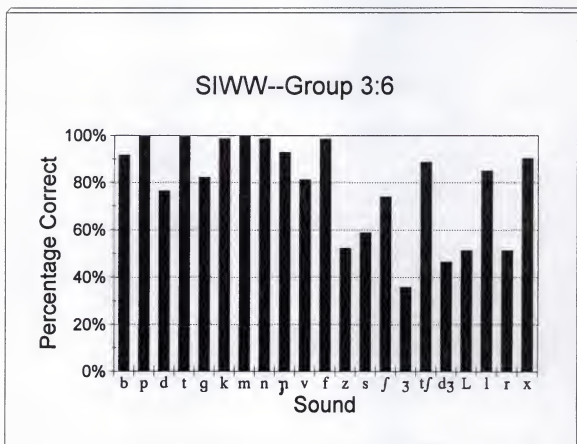


Figure 4-13. Percentages of accuracy of each consonant in the SIWW position for Group 3:6.

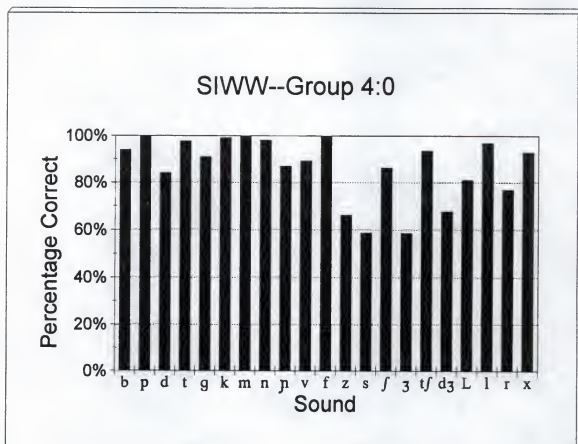


Figure 4-14. Percentages of accuracy of each consonant in the SIWW position for Group 4:0.

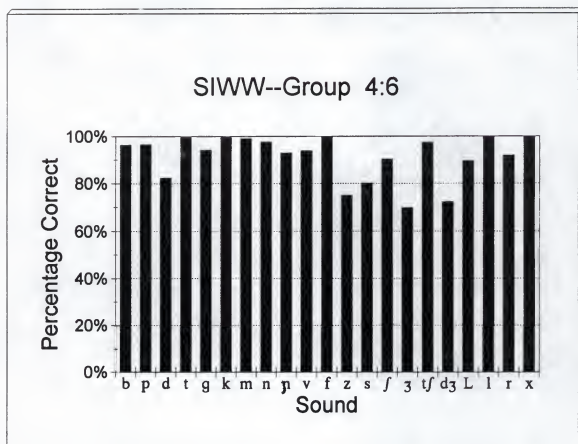


Figure 4-15. Percentages of accuracy of each consonant in the SIWW position for Group 4:6.

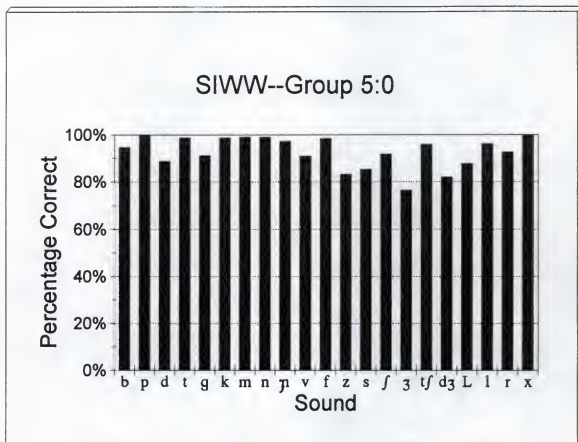


Figure 4-16. Percentages of accuracy of each consonant in the SIWW position for Group 5:0.

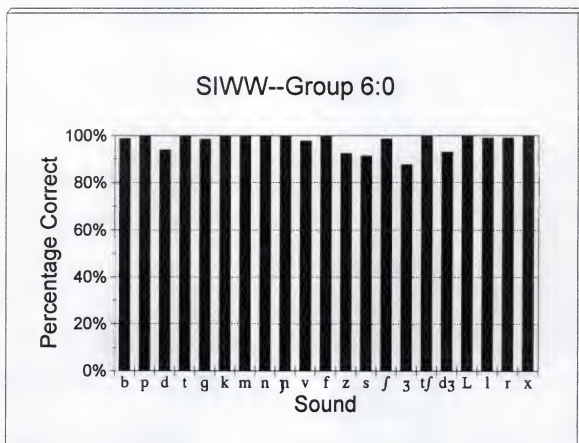


Figure 4-17. Percentages of accuracy of each consonant in the SIWW position for Group 6:0.

A tendency to produce voiceless sounds more accurately than voiced sounds can be seen again for all age groups. As in the SIWI position, a growth spurt can be seen between Group 2:0 and Group 2:6, especially on nasals and stops. It should be noted that four liquids were possible in this position as opposed to SIWI, where only two occur. The inclusion of these two additional consonants, the /L/ and the /r/, in SIWW position appeared to affect the overall performance on the liquids. The /l/ and /R/ (indicated on figures as /x/ because of font restrictions) showed approximately equally correct production, over 75% at Group 3:0. However, the /L/ and /r/ lagged behind and did not reach 75% correct until 4:0 or later. The affricates were produced correctly earlier than the fricatives. The voiceless affricate /tʃ/ was again more accurate than the voiced cognate /dʒ/. The fricatives were produced correctly later than the other sounds, with the exception of /f/ and /v/.

Comparison of Percentages of Correct Production by Position

Table 4-3 (also presented as Table 3-3) illustrates that most consonants tested are possible in only two positions, SIWI and SIWW. Portuguese has very few consonants that are either syllable final or word final. In the SFWF position only /s/ and /r/ occur, whereas in the SFWW position /n/, /s/, and /r/ occur. Variants used in some geographical areas also would include final /l/. Other areas would consider final /ʃ/ and /R/ instead of /s/ and /r/ as correct productions.

In the next section each group will be considered, starting with the youngest group, 2:0. The results are illustrated on three figures for each group,

Table 4-3. Distribution of consonants by position. SIWI=syllable-initial, word-initial; SIWW=syllable-initial, within-word; SFWW=syllable-final, within-word; SFWF=syllable-final, word-final.

	SIWI	SIWW	SFWW	SFWF	Total per sound
b	10	7			17
p	11	4			15
d	4	22			26
t	6	11			17
g	5	6			11
k	10	13			23
m	4	4			8
n	4	10	12		26
ɲ		3			3
v	4	8			12
f	9	3			12
z	2	5			7
s	5	10	8	5	28
ʃ	2	3			5
ʒ	3	5			8
tʃ	3	5			8
dʒ	3	3			6
l	3	12			15
r		9	6	3	18
x	4	3			7
Total per position	92	151	26	8	277

the first showing stops, the second showing fricatives and affricates, and the third showing nasals and liquids.

Group 2:0. Figures 4-18 to 4-20 show the accuracy of stops, nasals and liquids, and fricatives and affricates, respectively, in the two positions tested. It can be seen that children in Group 2:0 were more accurate in the SIWW position than in SIWI for all sounds. The liquid /r/ in all positions, including the SFWF, starts with a very low percentage of correct production by Group 2:0. The fricative /s/ in SFWW also has a low percentage of correct production in the early age groups.

Group 2:6. In Figures 4-21 to 4-23 it can be seen that the accuracy for most sounds in the SIWW position is still somewhat higher than in the SIWI position. However, a reversal can be seen for the stops /d/ and /g/, the fricative /z/, and the affricate /dʒ/. All three of these voiced sounds are now produced more accurately in the SIWI position. Group 2:6 continued to show a much higher percentage of correct production of the fricative /s/ in SFWF than in SFWW.

Groups 3:0-6:0. In the next group, 3:0, Figures 4-24 to 4-26 show that the accuracy of the SIWW is practically level with the SIWI position for all sounds, except /p/. This trend towards more equal accuracy of production for the two positions can be seen in Figures 4-27 to 4-41 to continue for all groups and all sounds from Group 3:6 to Group 6:0.

A t-test was performed using percentages of correct production of all sounds for each of the three youngest groups to evaluate the difference between

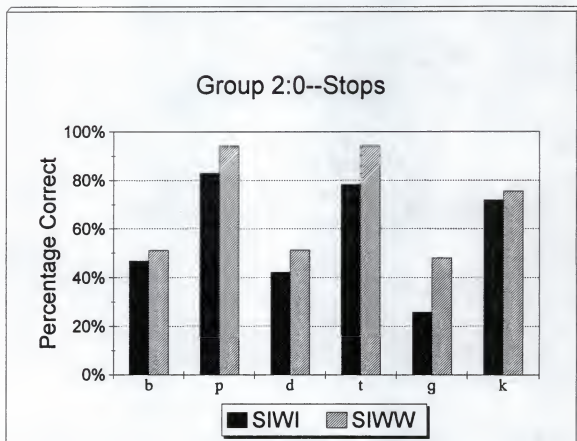


Figure 4-18. Comparison of accuracy of stops in SIWI and SIWW positions for Group 2:0.

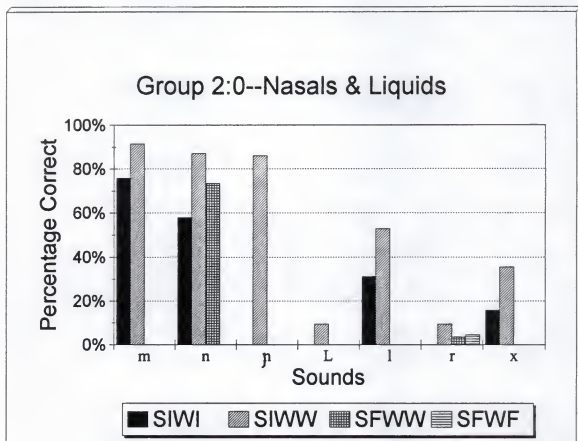


Figure 4-19. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 2:0.

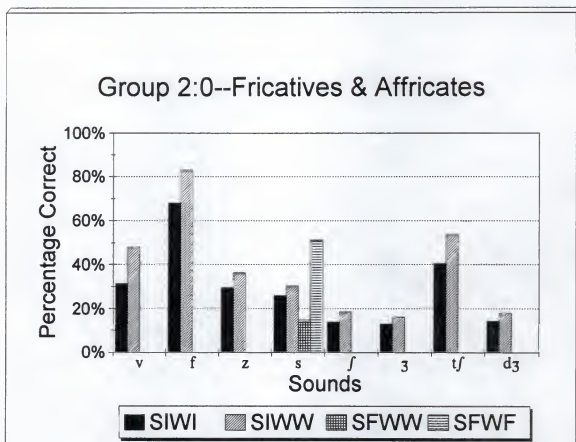


Figure 4-20. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 2:0.

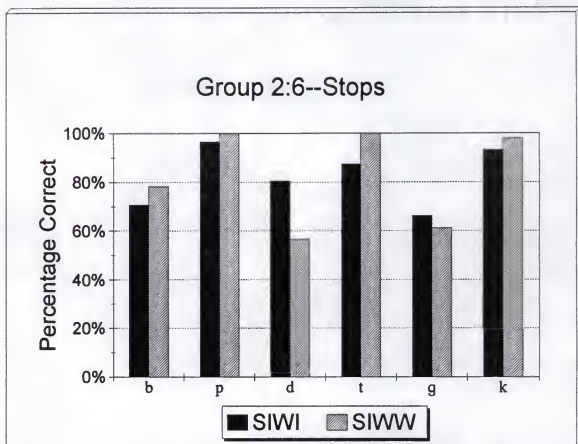


Figure 4-21. Comparison of accuracy of stops in SIWI and SIWW positions for Group 2:6.

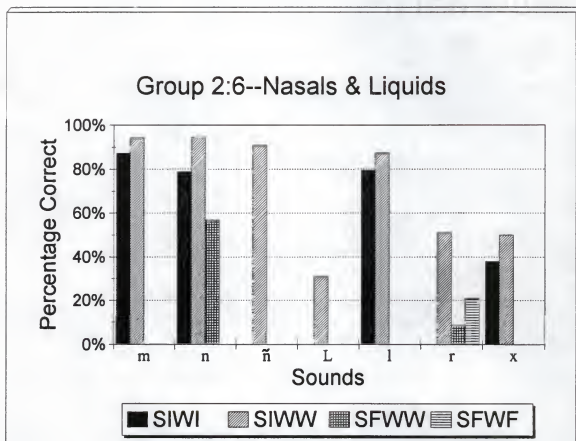


Figure 4-22. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 2:6.

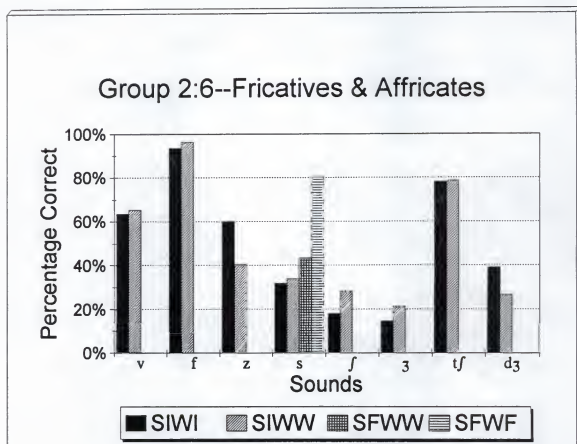


Figure 4-23. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 2:6.

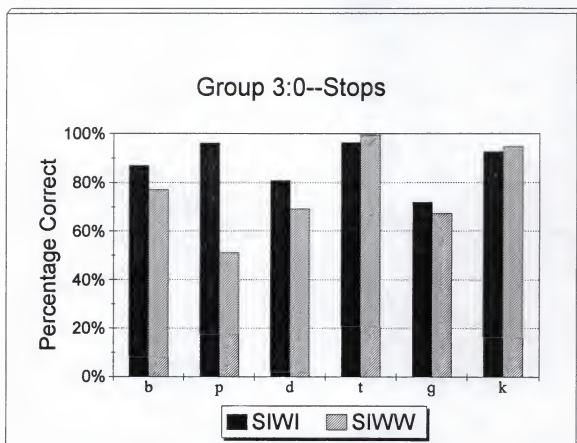


Figure 4-24. Comparison of accuracy of stops in SIWI and SIWW positions for Group 3:0.

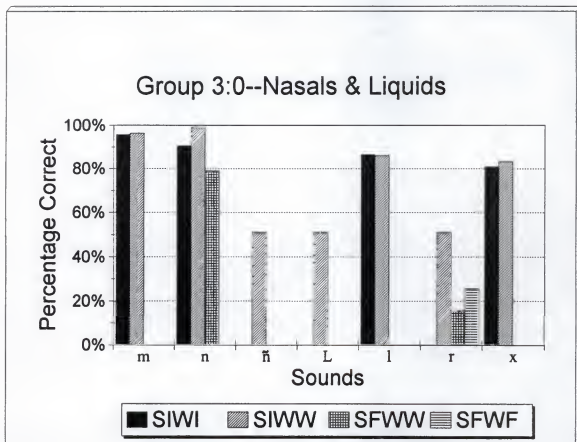


Figure 4-25. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 3:0.

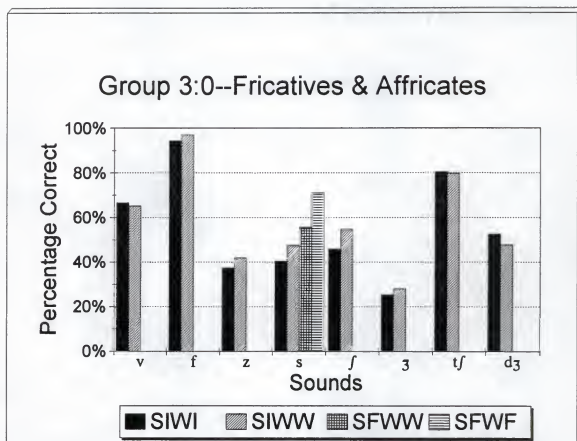


Figure 4-26. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 3:0.

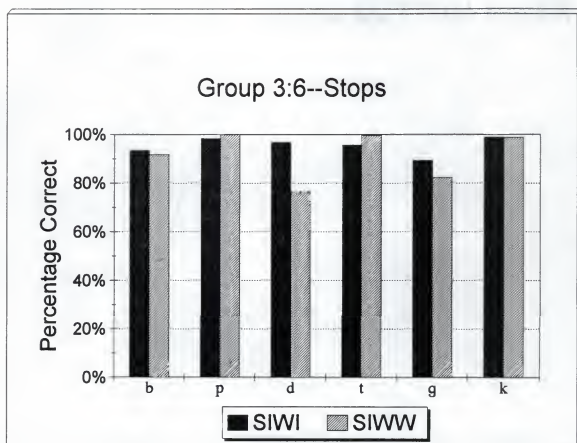


Figure 4-27. Comparison of accuracy of stops in SIWI and SIWW positions for Group 3:6.

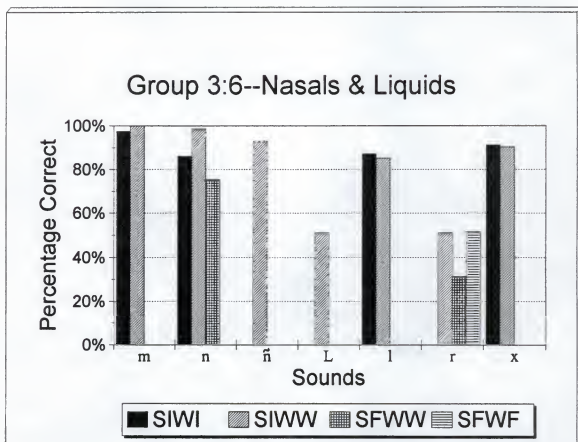


Figure 4-28. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 3:6.

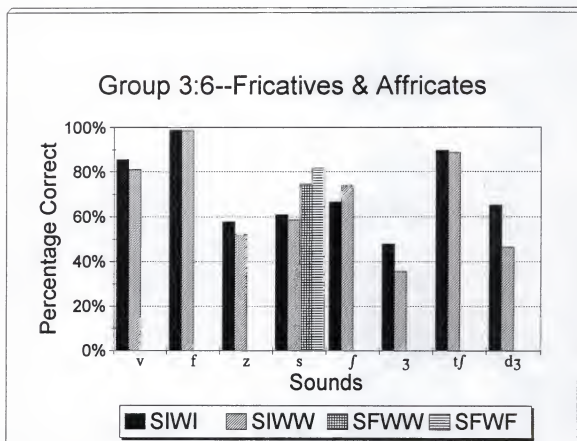


Figure 4-29. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 3:6.

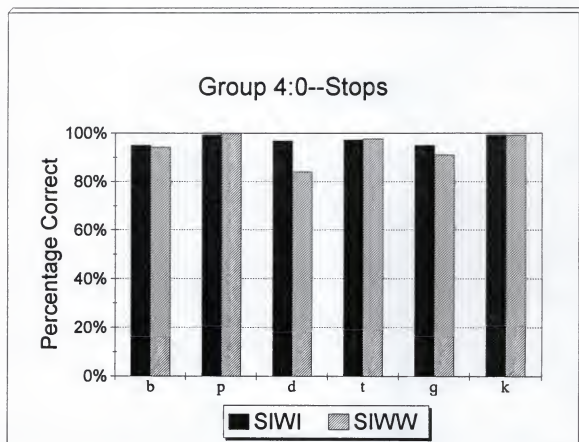


Figure 4-30. Comparison of accuracy of stops in SIWI and SIWW positions for Group 4:0.

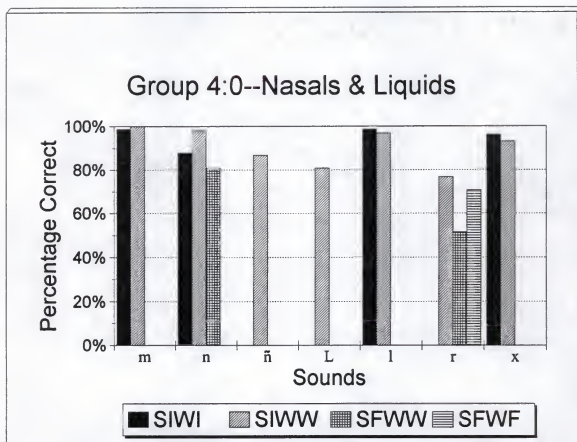


Figure 4-31. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 4:0.

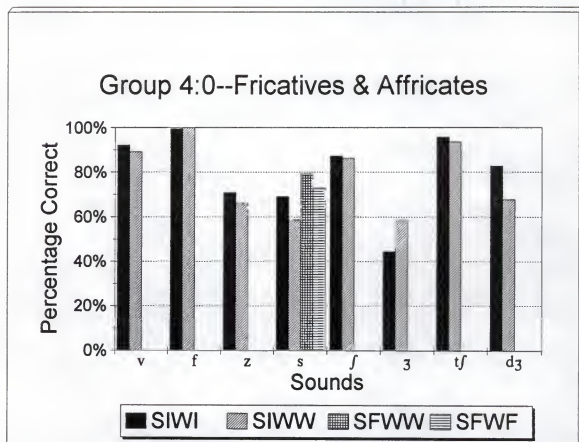


Figure 4-32. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 4:0.

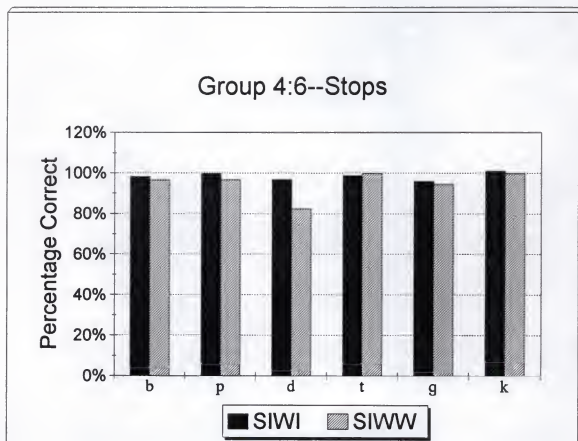


Figure 4-33. Comparison of accuracy of stops in SIWI and SIWW positions for Group 4:6.

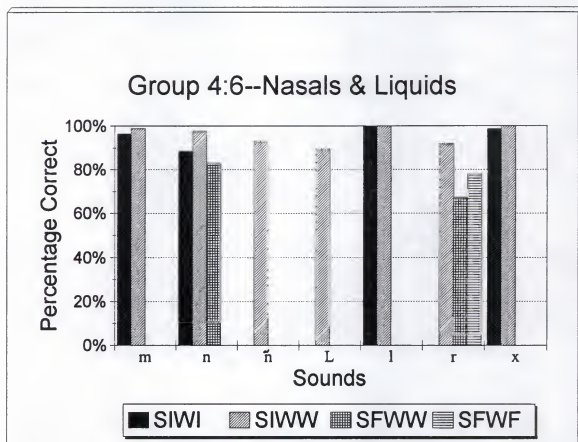


Figure 4-34. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 4:6.

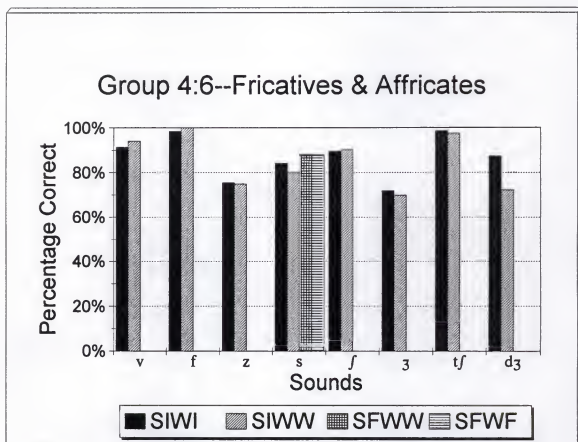


Figure 4-35. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 4:6.



Figure 4-36. Comparison of accuracy of stops in SIWI and SIWW positions for Group 5:0.

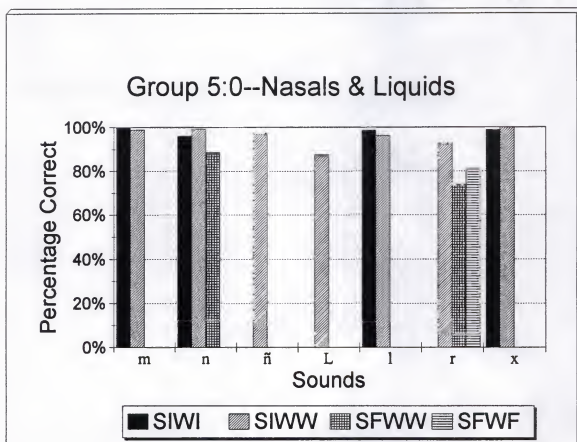


Figure 4-37. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 5:0.

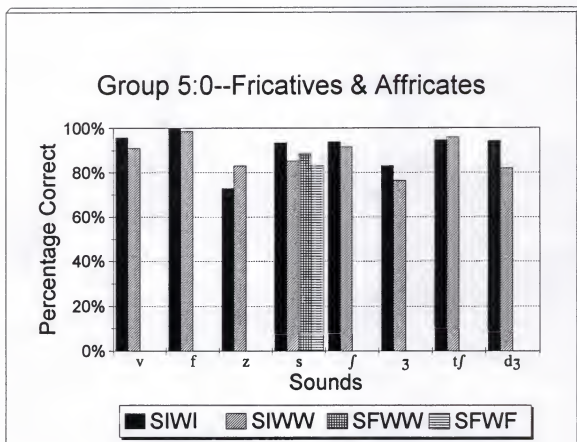


Figure 4-38. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 5:0.

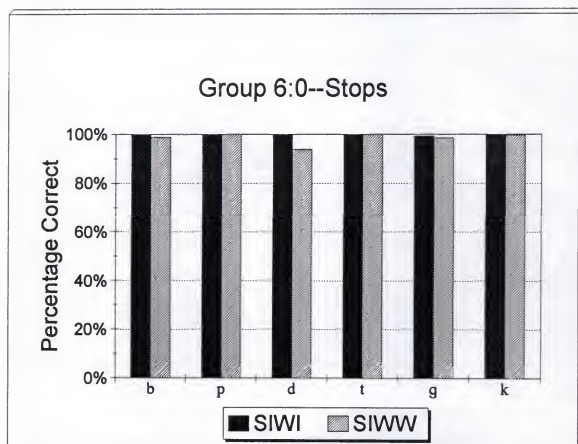


Figure 4-39. Comparison of accuracy of stops in SIWI and SIWW positions for Group 6:0.

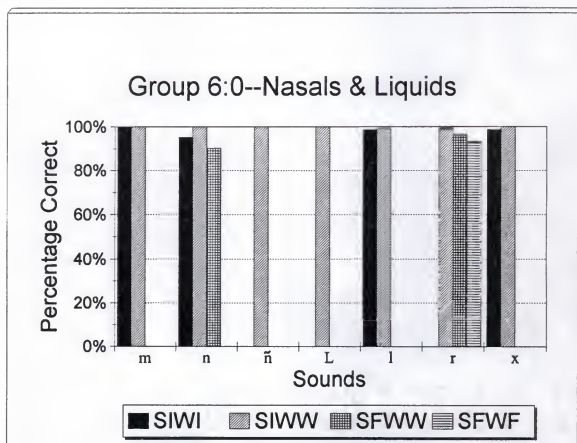


Figure 4-40. Comparison of accuracy of nasals and liquids in SIWI and SIWW positions for Group 6:0.

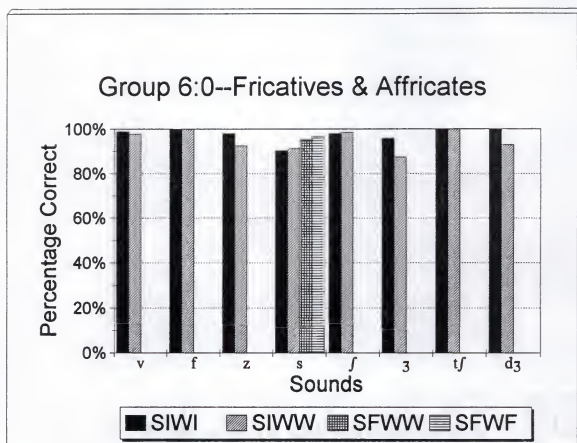


Figure 4-41. Comparison of accuracy of fricatives and affricates in SIWI and SIWW positions for Group 6:0.

the SIWI position and the SIWW position. Only Group 2:0 showed a significant difference at the .05 level ($t = -6.594$, $df = 17$). The apparent differences in accuracy, favoring SIWW in the second group and SIWI in the third, were not significant ($t = -.741$ and $.695$, respectively, $df = 17$, $p = .05$). Because the differences in position were even smaller in the older groups, the statistical test was not repeated for these groups.

The one sound that appears to be produced more accurately in the SIWI across all ages is the /d/. It is possible that the /d/ presents a higher percentage in the SIWI position than in the SIWW position due to the fact that many verbs were used in the progressive form. In Portuguese the /nd/ is used to indicate this form (e.g., *nadar/nadando*, for *swim/swimming*), and the /d/ tends to be dropped in casual speech (e.g., /nadandu/ → [nadanu]).

Clusters

It should be noted that only two types of consonant clusters occur regularly in Portuguese. These consist of a stop or fricative plus /r/ or /l/ (e.g., *prato*, *flor*; *plate*, *flower*). As previously mentioned, the /nd/ sequence is used to indicate the present progressive form of verbs. It is considered a sequence rather than a cluster because one consonant is perceived as ending a syllable and the second as beginning the next syllable. Figure 4-42 illustrates the percentages of correct /r/ and /l/ clusters and the /nd/ sequence across age groups. It can be seen that neither the /r/ nor /l/ cluster was used very accurately in the early age groups. At 4:6 there is an increased percentage of correct production of the clusters that

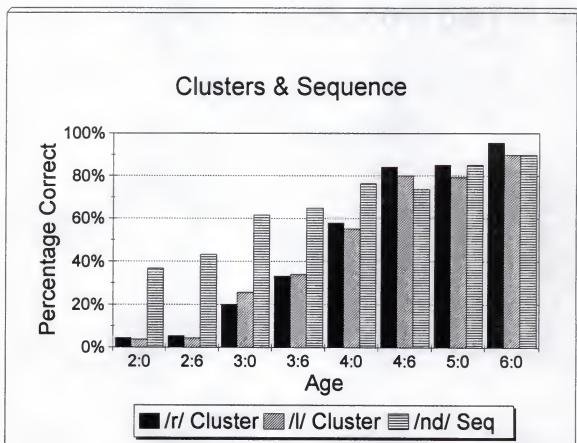


Figure 4-42. Percentages of correct production of two types of clusters and the /nd/ sequence by each group.

continues gradually through Group 6:0. The sequence /nd/ shows a higher percentage of accuracy at the younger ages, leveling with the clusters by Group 4:6 and continuing to increase steadily with age.

Comparison of Percentages of Correct Production of Boys and Girls

The percentage of correct consonants produced by boys and girls was analyzed separately to investigate the possible difference in performance between the two groups. Figure 4-43 shows these percentages graphically. It can be seen that very little difference between the two groups occurred. A t -test was run for the percentages of consonants produced correctly at each age to determine if this was a significant difference. In fact, no significant difference was found between the two sets of scores ($t = -1.286$, $df = 8$, $p = .05$).

Question 2. What is the age of "customary production" for each sound?

Question 3. What is the age of "acquisition" for each sound?

Question 4. What is the age of "mastery" for each sound?

These three questions will be addressed together in this section. The traditional definitions of these ages have been offered by Sander (1972). One variation from Sander's recommendations was needed for adaptation to Portuguese. Customary age is traditionally defined as the age at which 50% of the children in an age group produce a sound correctly in at least two positions. Because most consonants only occur in two positions in Portuguese, *customary age* was defined as the age at which at least 50% of the productions of a sound in an age group were correct in all positions tested. The other two ages were used with

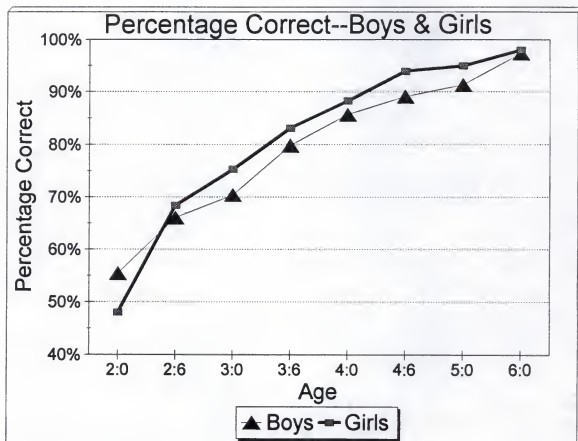


Figure 4-43. Comparison of accuracy of consonants produced by boys and girls in each group.

only minor variation from Sander's standard. The *age of acquisition* was defined as the age at which at least 75% of the productions of the sound by an age group were correct in all positions tested. The *age of mastery* was defined as the age at which at least 90% of the productions of a sound by an age group were correct in all positions tested. Figure 4-44 illustrates the customary, acquisition, and mastery ages. The horizontal axis shows all the sounds tested, from /b/ to /r/. The vertical axis shows the age groups which are represented here by decimal points, e.g., 4.5 equals age 4:6—4:10, or Group 4:6. The lower end of each bar, represented by a solid square, is at the customary age for each sound; the upper end of each bar, represented by lighter shaded square, is at the mastery age. Within each bar a third symbol, darker shaded bar, falls at the age of acquisition. In some cases these ages occurred within the same group, resulting in less than three symbols on the bar. It should be noted that the bars that begin at the bottom line, 2, indicate that the sound was customary by the first testing and probably was customary before 2:0.

/b/-/p/

The /b/ sound was customary at 2:6, acquired at 3:0, and mastered at 3:6. The /p/ was customary somewhat earlier, before 2:0. In fact, /p/ was also acquired before 2:0 and mastered at 2:6.

/d/-/t/

The /d/ sound was customary at 2:6, acquired at 3:0, and mastered at 6:0. The /t/ sound was customary and acquired before 2:0 and mastered at 3:0.

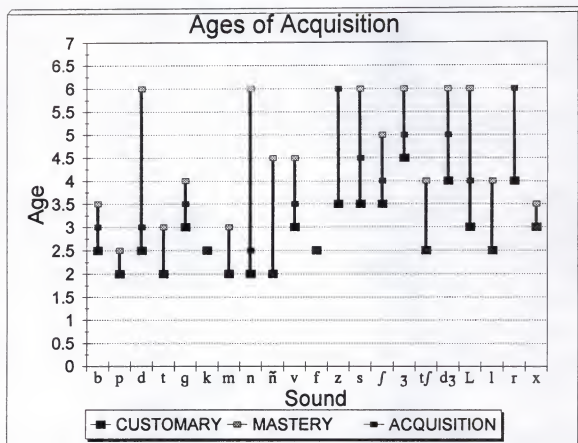


Figure 4-44. Customary, mastery, and acquisition ages of each consonant.

/g/-/k/

The /g/ sound was customary at 3:0, was acquired at 3:5, and was mastered at 4:0. The /k/ sound was customary, acquired and also mastered at the same age, 3:0.

/m/-/n/-/ɱ/

The /m/ sound was customary and acquired before 2:0, and mastered at 3:0. The /n/ was customary at 2:0, acquired at 2:5, and mastered at 6:0. The /ɱ/ sound was customary and acquired at 2:0, and mastered at 4:6.

/v/-/f/

The /v/ sound was customary at 3:0, acquired at 3:6, and mastered at 4:6. The voiceless cognate /f/, one of the earliest sounds, was customary, acquired, and mastered at 2:0.

/z/-/s/

The /z/ sound was customary at 3:6, and acquired and mastered at 6:0. The /s/ was customary at 3:6, acquired at 4:5, and mastered at 6:0.

/ʃ/-/ʒ/

The /ʃ/ sound was customary at 3:6, acquired at 4:0, and mastered at 5:0. The /ʒ/ was customary at 4:5, acquired at 5:0, and mastered at 6:0.

/tʃ/-/dʒ/

The /tʃ/ was customary and acquired at 2:6 and mastered at 4:0. The /dʒ/ was customary at 4:0, acquired at 5:0, and mastered at 6:0.

/L/-/l/-/r/-/R/

The /L/ was customary at 3:0, acquired at 4:0, and mastered at 6:0. The /l/ was customary and acquired at 2:6 and mastered at 4:0. The /r/ was customary at 4:0, acquired and mastered at 6:0. The /R/ was customary and acquired at 3:0 and mastered at 3:6.

Reliability

The independent transcriptions of one subject from each group were compared and analyzed for agreement using the reliability program included with the LIPP (Oller & Delgado, 1990). This program compares the structure of the word and the consonants heard by each listener and yields a proportion of agreement based on weights assigned to different features. For example, disagreements as to the structure of a word are weighted twice as high as disagreements about the specific consonant. The individual agreement scores for the eight subjects ranged from .974 to .989 and averaged .982. This figure indicates a high level of agreement between the two listeners.

CHAPTER 5 DISCUSSION

The findings of this study will be discussed in several different ways. First, they will be compared to many of the studies of phonological acquisition reported in Chapter 2. Both factors that support and those that contradict earlier studies will be discussed. Second, the strengths, weaknesses, and limitations of the test instrument and procedures will be presented. Suggestions for further research in this field will be made, and finally, conclusions from this study will be drawn.

Comparisons With Other Studies

Percentages of Correct Production

The general order of sound acquisition agreed with most reported studies of Portuguese (Lamprecht, 1993; Silverio et al., 1994; Wertzner, 1992; Yavas, 1988), with the studies of English that were reviewed (Irwin & Wong, 1983; Khan & Lewis, 1986; Prather et al., 1975; Sander, 1972; Smit et al., 1990; Templin, 1957), and with the one available study of Arabic (Al Amayreh, 1994). Stops (plosives) and nasals were generally produced correctly before fricatives, affricates, and liquids. Lamprecht (1993) and Yavas (1988) carried this ordering of acquisition further by indicating the following sequence: plosives/nasals > fricatives > liquids. One exception to their order was seen in the present study. With only minor exceptions (/r/ and /f/), the liquids were acquired before the fricatives, yielding: stops/nasals > liquids > fricatives. Within manners of

articulation, Lamprecht found: labials > dental/alveolars > palatals > velars.

However, the present study supported this finding for fricatives and stops but not for nasals. These findings also agree with those of Yavas (1988), Ferguson and Farwell (1975), and Edwards (1979) in predicting that anterior fricatives would be acquired before posterior fricatives. Lamprecht's findings for liquids were well supported by the present study. In both studies /l/ was acquired before /L/, and /R/ was acquired before /r/.

Hernandorena (1993) reported that the sounds /p/, /t/, /k/, /m/, and /n/ in Portuguese were produced correctly 85% of the time by her youngest group (2:0), and the /l/ was produced correctly 85% of the time by the 2:6 group. All of these findings were supported by the present study.

It was difficult to compare the data from this study with the Portuguese data of Silverio et al. (1994) because of the different treatment of the criterion for acquisition. Silverio et al., in fact, were not concerned with acquisition, but with "occurrence" of a sound. Any sound produced correctly one time out of three possible productions was included in their lists. Even though the comparison was not perfect, the closest parallel in the present study would be the ages of customary usage. Silverio et al. listed the following sounds as "occurring" in 100% of the youngest group of children, aged 2:6 to 3:6: /m, n, p, b, d, k, g, f, v, tʃ, dʒ/. If customary ages from the present study are used, the list of those "customary" before 3:6 is almost identical with that of Silverio et al.: /m, p, b, t, d, k, g, f, v, tʃ,

l, R/. The data from this study included the addition of /t/, /l/, and /R/ and the deletion of /dʒ/ from the list of Silverio's et al.

As mentioned above, the present study agreed in many ways with that of Yavas (1988). However, Yavas found /m/ and /n/ to be acquired (75%) earlier than /ɲ/. In this study /m/, /n/, and /ɲ/ were acquired by 2;0.

Many of the studies reviewed have neglected to mention the effect of position on the accuracy of consonants. Lamprecht (1993), however, reported that word final /s/ and /r/ were produced correctly earlier than the same sounds in the syllable final position within words. The present study supported this finding for both /s/ and /r/. It might be hypothesized that the /s/ was used earlier at the ends of words because of its role in formation of the plural morpheme. No other word final /s/ singleton typically occurs in Portuguese. This hypothesis cannot be extended completely to the /r/, although it does occur in word final position in the infinitive form of verbs. However, it also occurs as a final consonant in other types of words and among the words used in this research, e.g., *flor*, *açucar*, *trator*, *flower*, *sugar*, and *tractor*.

Little mention of the role of voicing has been made in other studies of Portuguese acquisition. Generally, it has been reported that in languages of the world, voiced consonants are acquired earlier in the word initial position, and voiceless consonants are acquired first in word final position (Ferguson & Farwell, 1975; Stampe, 1969, 1973). However, the present study of Portuguese contradicts these predictions. All voiceless consonants regardless of position produced by

these children were acquired (75% correct) earlier than their respective voiced cognates. It is difficult to account for this major disagreement. Further study of this issue, possibly examining errors made on these sounds, is certainly warranted.

Customary and Mastery Ages

The ages of customary usage and of mastery in this study were compared with those of Sander (1972) for English and of Al Amayreh (1994) for Arabic. Although there were minor differences in definition, a comparison seemed to be warranted on sounds occurring in all three languages. Figures 5-1 and 5-2 present these ages graphically. In each case, the Portuguese data appear as the leftmost bar, followed by the Arabic data, and finally the English data. The lower end of each bar represents customary age; the upper end represents the age of mastery.

The customary age of no consonant was earlier for Portuguese than for the other languages. However, the age of mastery was earlier for Portuguese than for either of the other languages on all consonants except /d/, /m/ (earlier than Arabic), and /r/. These Portuguese speaking children began to produce many consonants later than those speaking the other two languages, but they often mastered the sounds earlier.

Strengths, Weaknesses, and Limitations

The test instrument used for collection of the data was already available and had been used for at least two previous studies. Its use allowed a more direct comparison of these data with those of the earlier studies. The test appeared to sample the sounds of the language adequately. All sounds were tested at least

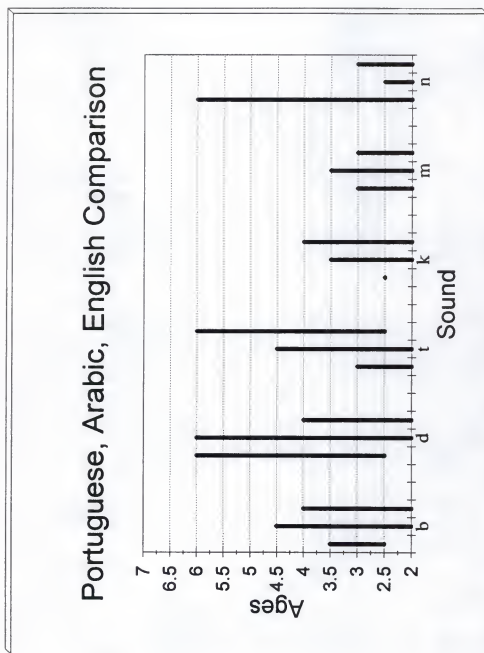


Figure 5-1. Comparison of customary and mastery ages of Portuguese, Arabic, and English stops and nasals.

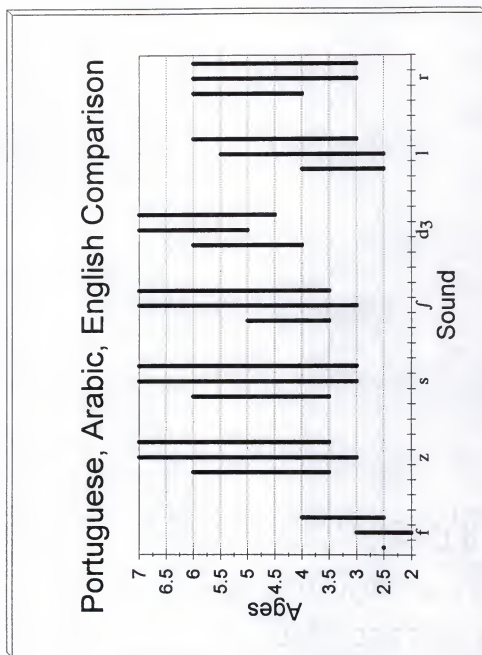


Figure 5-2. Comparison of customary and mastery ages of Portuguese, Arabic, and English fricatives, affricates, and liquids.

three times in each possible position, with the exception of a few low incidence sounds. However, this thoroughness can be seen as both an advantage and a disadvantage. Because of its length, the test would be most useful to the speech-language pathologist as a part of a diagnostic battery. It could not easily be used to screen the articulation/phonologic abilities of large populations.

The presentation of the pictures in a simple theme format with many items in each picture probably elicited more spontaneous responses than a simple, picture-naming test would have. In addition, these words were not just nouns, but verbs, adjectives, greetings, and other word types. However, several words required the examiner to cue with a question (e.g., "What color is this grass?" or "Is this a big dragon or a small dragon?"), which was very time consuming with some children. An interesting aspect of the questioning was that often the children gave the opposite answer than was expected (e.g., saying that the dragon was *small* when the answer should have been *big*). In fact, such responses were a pleasant aid in establishing a good rapport with the children.

The pictures were very much liked by the children. Some of them made up stories and were very creative. Usually the children seemed to enjoy the testing. However, the younger children, 2:0 to 3:6, often lost interest before the end of the session, requiring the examiner to use extra effort to keep them going until the end.

The materials were very convenient and easy to manipulate. Only three 8 inch by 11 inch laminated pictures were needed, together with the transcription

sheets and the tape recorder. Different transcription sheet than the ones suggested by Yavas et al. (1991) were used (Appendix A) to facilitate recording the responses. Another change made was the coloring of the pictures by the author to make them more interesting for the children.

Suggestions for Further Research

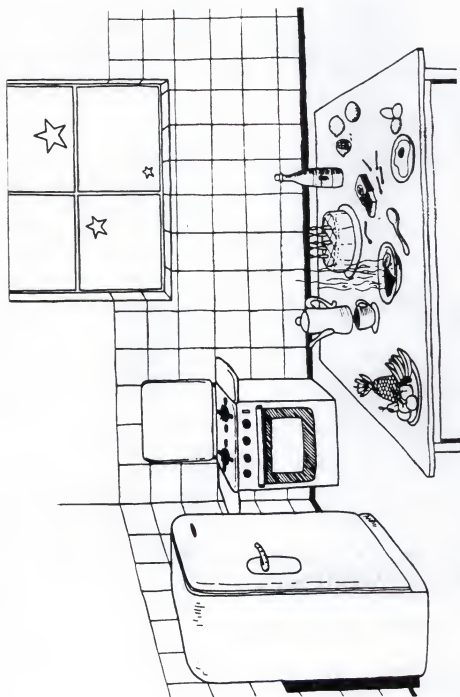
Three major suggestions for further research grew out of this study. Although the sample of children tested was quite large, 192, all of the children were from the same geographic area in Brazil. It would be useful to replicate this study with Portuguese speaking children from other areas. A second suggestion concerns the errors made by these normal children in producing the words. A further analysis of these errors would yield valuable information about the normal phonological acquisition process. The third suggestion is related to the second, but involves the validation of these data with children whose phonological development is not following a normal pattern for some reason. Would the results yielded from testing such children differ significantly and in what ways from the results of these normal children?

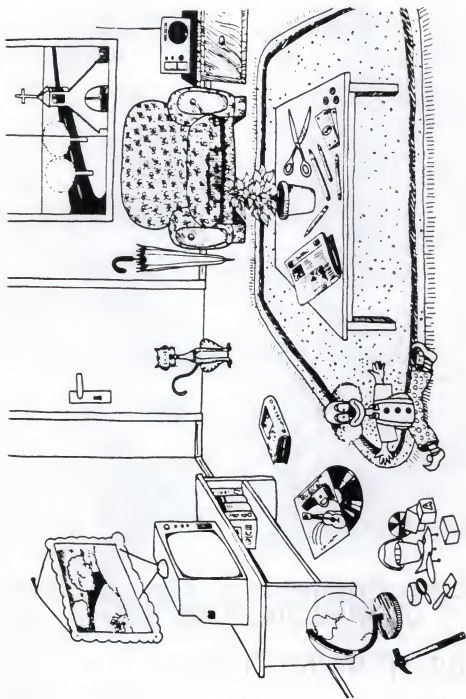
Conclusions

In summary, the results of this study can be restated to highlight the major conclusions about the normal acquisition of Portuguese.

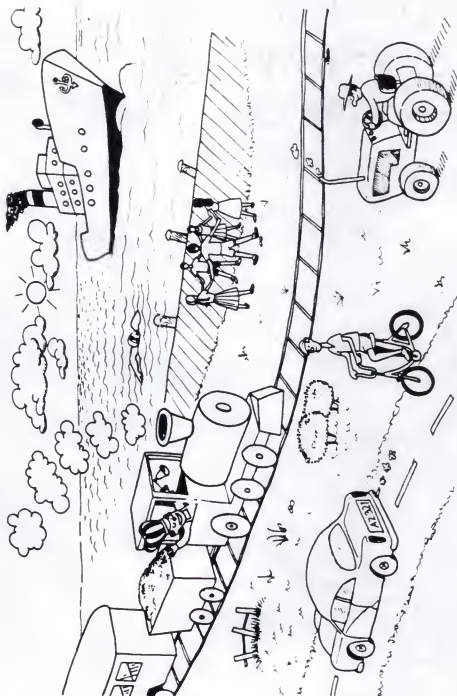
1. Some consonants appear to have been acquired even before the age of the youngest group, 2;0.

2. Nasals and stop consonants were produced correctly earlier than fricatives and liquids. However, most liquids were produced correctly earlier than most fricatives.
3. The period of the greatest growth in accuracy of consonant production was between 2:0 and 2:6.
4. By 4:0 most of the consonants were produced with at least 75% accuracy.
5. There was a tendency among these children to produce voiceless consonants more accurately than their voiced cognates, even at the beginnings of words.
6. The syllable-initial, within-word position was more accurate in the younger groups than syllable-initial, word-initial, reversing on most sounds at about 3:0 or 3:6, and then showing no difference later.
7. Early sounds (those acquired before the age of 3:0) included: /p/, /t/, /k/, /m/, /n/, /ŋ/, /f/, /tʃ/, and /l/.
8. Intermediate sounds (those acquired between 3:0 and 4:0) included: /b/, /d/, /g/, /v/, and /R/.
9. Late sounds (those acquired at 4:0 or later) included: /z/, /s/, /ʃ/, /ʒ/, /dʒ/, and /r/.
10. There was essentially no difference between girls and boys in ages of acquisition.









APPENDIX B
TRANSCRIPTION SHEET

ZOO

F or M - Group

borboleta	b o r b o l e t a		1
cachorro	k a f o r u		2
cobra	k o b r a		3
comer	k o m e r (k o m e n d u)		6
dois	d o i s		5
dragão	d r a g π w		6
flôr	f l o r		7
floresta	f l o r e s t a		6
grama	g r a m a		9
grande	g r π d i		10
latir	l a t i r (l a t f i n d u)		11
olhar	o L a r (o L π n d u)		12
passarinho	p a s a r i ñ u		13
pedra	p e d r a		14
peixe	p e j f		15
pular	p u l a r (p u l π n d u)		16
rabo	R a b u		17
sol	s w		10
tigre	t f g r i		19
verde	v e r d i		20
zebra	z e b r a		21
zoológico	z o o l i k u		22
orelha	o r e L a		23
voar	v u a r (v u π n d u)		24

KITCHEN

F or M - Group

abacaxi	a b a k a f i		1
açucar	a s u k a r		2
café	k a f e		3
estrela	i s t r e l a		4
feijão	f e j π w		5
fogão	f o g π w		6
frio	f r i w		7
fruta	f r u t a		8
garrafa	g a R a f a		9
geladeira	e l a d e j r a		10
janela	a n e l a		14
prato	p r a t u		12
soprar	s o p r a r		13
vela	v e l a		14
vidro	v i d r u		15
banana	b a n π n a		16
bolo	b o l u		17
fogo	f o g u		18
ovo	o v u		19
tampa	t π p a		20

LIVING ROOM

F or M - Group

brinquedo	b r i k e d u	1
cruz	k r u s	2
dinheiro	d i ñ e j r u	3
disco	d i s k u	4
globo	g l o b u	5
guarda-chuva	g w a r d a f u v a	6
igreja	i g r e a	7
jornal	o r n a w	8
lápis	l a p s	9
livro	l i v r u	10
martelo	m a r t e l u	11
mesa	m e z a	12
palhaço	p a L a s u	13
planta	p l π t a	14
prego	p r e g u	15
quadro	k w a d r u	16
rádio	R a d u	17
tapete	t a p e t f i	18
televisão	t e l e v i z π w	19
tesoura	t f i z o r a	20
antena	π t e n a	21
botão	b o t π w	22
estante	i s t π t f i	23
franja	f r π a	24
poltrona	p o l t r o n a	25
telhado	t e L a d u	26

BATHROOM

F or M - Group

banquinho	b ʌ k i ñ u		4
blusa	b l u z a		2
bolso	b o w s u		3
braço	b r a s u		4
calça	k a w s a		5
camisa	k a m i z a		6
chave	f a v i		7
chinelos	f i n e l u		8
dedo	d e d u		9
dente	d e j t f i		10
escovar	i s k o v a r (i s k o v x n d u)		11
nariz	n a r i s		12
pescoço	p e s k o s u		13
relógio	R e l i w		14
sabonete	s a b o n e t f i		15
toalha	t u a L a		16
esperar	i s p e r a r (i s p e r x n d u)		17
armário	a r m a r i o		18
azulejos	a z u l e o s		19
cabelo	k a b e l u		20
cano	k ʌ n u		21
espelho	i s p e L u		22
menino	m e n i n u		23
perna	p e r n a		24
porta	p o r t a		25
saia	s a i a		26
sapato	s a p a t u		27

VEHICLES

F or M - Group

andar	π n d a r (π n d π n d u)	4
bicicleta	b i s i k l e t a	2
brincar	b r i k a r (b r i k π n d u)	3
carro	k a r u	4
crianças	k r i π s a s	5
dizer	d i z e r (d i z \tilde{e} n d u)	6
dirigir	d i r i i r (d i r i i n d u)	7
estrada	i s t r a d a	8
frente	f r \tilde{e} j t f i	9
fumaça	f u m a s a	10
microfone	m i k r o f o n i	11
andar	n a d a r (n a d π n d u)	12
nuvem	n u v \tilde{e} j	13
placa	p l a k a	14
tia/tio	t f i a / t f u	15
tocar	t o k a r (t o k π n d u)	10
trator	t r a t o r	17
trêm	t r \tilde{e} j	10
âncora	π n k o r a	19
chaminé	f a m i n e	20
navio	n a v i w	21
roda	R d a	22
trilho	t r i L u	23
sino	s i n u	24

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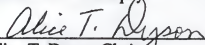
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BIOGRAPHICAL SKETCH


Celia R. Salviano Santini was born on November, 22, 1960, in Brazil. She was married in 1985 and now has a young son. She worked as a speech therapist for the last 12 years. In 1979, she joined the Pontificia Universidade Catolica in Sao Paulo, graduating with a Bachelor of Arts in speech-language pathology in 1982. She enrolled in a two year specialization course at CEFAC in 1983, and after receiving her diploma, she started teaching at that center. After entering the graduate program at the Pontificia Universidade Catolica in 1987, Department of Communication Disorders, she was appointed as a teaching and research assistant in the same department. Celia received her Master of Science in October, 1989. In August of 1991, she enrolled in the graduate program at the University of Florida, Department of Communication Processes and Disorders. Her Ph.D. in communication disorders should be awarded in December, 1995.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.



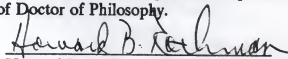
Alice T. Dyson, Chair
Associate Professor of Communication
Processes and Disorders

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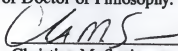
Linda J. Lombardino, Cochair
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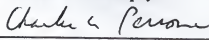
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Christine M. Sapienza
Assistant Professor of Communication
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This dissertation was submitted to the Graduate Faculty of the Department of Communication Processes and Disorders in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1995

Dean, Graduate School

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